UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

OFFICE OF CHEMICAL SAFETY AND
POLLUTION PREVENTION

PC Code: 124002
DP Barcodes: 385667, 387408, 387407, and 389832
Date: May 23, 2011

TRANSMITTAL MEMO

SUBJECT: Ecological Risk Assessment to Support the Proposed Section 3 Uses of Novaluron to Control Crickets in Residential Areas, and to Control Mosquito Larvae in Small Water Bodies

TO: John Herbert, Risk Manager
Jennifer Gaines, Risk Manager Reviewer
Registration Division (7505P)

FROM: Alicia Korol, Biologist
Robert A. Miller, Environmental Protection Specialist
Environmental Risk Branch I
Environmental Fate and Effects Division (7507P)

THRU: Dr. Nancy Andrews, Branch Chief
Environmental Risk Branch I
Environmental Fate and Effects Division (7507P)

The Environmental Fate and Effects Division (EFED) has revised the environmental fate and ecological risk assessment in support of the Section 3 registration decision on the insecticide novaluron. This transmittal memorandum accompanies the most recently revised version of the novaluron fate and ecological risk assessment, which supersedes the original fate and ecological risk assessment issued on May 12, 2011.

EFED has completed the request from the Registration Division to evaluate the ecological risk and environment fate of the proposed new uses of the insecticide novaluron ((RS)-1-[3-Chloro-4 (1,1,2-trifluoromethoxyethoxy)phenyl]-3-(2,6-difluorobenzoy1)urea, CAS # 1167-46-6). Novaluron is a non-systemic benzoylphenyl urea insect growth regulating insecticide that inhibits chitin biosynthesis and interferes in cuticle formation in insects belonging to the orders Lepidoptera, Coleoptera, Herniptera,

and Diptera. The proposed Section 3 registrations include the new use of novaluron, as formulated in RIMON® SUPRA 10EC Insecticide (9.3% a.i.), for the indoor and outdoor control of crickets. The second proposed Section 3 registration of novaluron is for the control of mosquito larvae in contained, small water bodies, as formulated in MOSQUIRON™ 0.12 P (0.12% a.i.) and MOSQUIRON™ 0.12 CRD (0.12% a.i.).

Novaluron's low water solubility and high soil adsorption coefficient indicate novaluron will strongly adsorp to soil and have limited ability to leach into groundwater. Novaluron's major route of degradation is microbial degradation. Aerobic soil and aqueous degradation half-lives range from 7-32 days and 10-51 days, respectively. Novaluron is stable to hydrolysis, aqueous photolysis, and soil photodegradation. The high lipophilicity (log Kow of 4.3) of novaluron suggests that it has a tendency to bioaccumulate.

Chlorophenyl urea and chloroaniline are novaluron metabolites of concern identified by the Health Effects Division (HED) for drinking water concern (MARC, 2004). Chlorophenyl urea is no more of a concern to aquatic organisms than novaluron based on chlorophenyl urea's and novaluron's low solubility limits relative to toxicity endpoints. Therefore, risk of chlorophenyl urea toxicity to aquatic organisms was not assessed and current aquatic risk analysis is based on the parent alone; however, risk to terrestrial organisms was assessed where data were available (*i.e.* terrestrial invertebrates). Environmental exposure and risk quotients were not calculated for chloroaniline because there are limited fate data and no terrestrial or aquatic ecotoxicity and/or toxicity data available.

***Exposure and Risk Conclusions* - RIMON® SUPRA 10EC Insecticide**

EFED calculated a maximum application rate of 0.91 a.i. lbs/A (1.02 kg/ha) from the proposed RIMON® SUPRA 10EC product label for outdoor perimeter and spot treatments. Consistent with EFED's standard scenarios used to model surface water runoff (PRZM and EXAMS models), it is conservatively assumed that a 10 ha watershed is treated with novaluron in a single day. This assumption is realistic when considering the pest management operations for a large retirement community or town home association. However, RIMON® SUPRA 10EC is unlikely to always be applied to an entire 10 ha surface area (including ground and building foundations) for a single application. Therefore, EFED modeled the outdoor perimeter and spot treatment use of novaluron at 1.0, 5.0 10, 25, and 100% of the assumed watershed (10 ha) to bound the aquatic exposure at estimated high and low use rates. For terrestrial exposure, the maximum use rate per acre (0.91 lbs a.i./A) was modeled.

Based on the screening-level risk assessment, EFED determined that the proposed application rate for perimeter and spot treatments is 3 times greater than currently registered maximum single application rate of novaluron (0.32 lbs a.i./A). **Therefore, the potential for ecologically adverse effects from the proposed oudoor perimeter and spot treatment use is greater than the uses previously assessed.** For the proposed use on crickets, chronic adverse effects to birds are expected for all herbivorous,

insectivorous, and granivorous birds (dietary RQs ranged from 1.39-22.3). Risk quotients for chronic dietary exposures to mammals also exceeded the Agency's LOC for the proposed use on crickets (does-based RQs $\leq$ 1.28). Based on the magnitude of the chronic avian RQs, a bird that obtained 5% of its dietary needs from novaluron treated areas would still consume a quantity of novaluron that exceeds the Agency's level of concern. For the proposed spray use of novaluron, where applications may not be contiguous over dietary items, adverse effects to birds are still expected. Based on the magnitude of the chronic mammal RQs, a mammal that obtained less than 100% of its dietary needs from novaluron treated areas would be less likely to be at chronic risk from the proposed novaluron spray uses.

There is the potential for adverse effects to beneficial insects (*i.e.* pollinators) because application to flowering plants is not prohibited. **EFED recommends the following protective label language that prohibits applications to blooming plants:**

> *In order to minimize the possibility of developmental effects on pollinator larvae, including honey bee brood, do not use RIMON® SUPRA 10EC on blooming plants*.

Adverse effects to all terrestrial invertebrates from chlorophenyl urea toxicity are presumed. Risks of novaluron toxicity to terrestrial plants are presumed due to lack of data. Due to novaluron's low solubility limit, acute risks to freshwater and estuarine/marine fish and chronic risk to freshwater fish are not expected; chronic risk to estuarine/marine fish are presumed due to lack of data. At the limit of solubility, all aquatic plant RQs were below the LOC and adverse effects to plants are not expected.

The RIMON® SUPRA 10EC label does not restrict the number of annual applications. In the Indoor and Outdoor Applications section on the RIMON® SUPRA 10EC product label it is stated that RIMON® SUPRA 10EC "inhibits the development of the immature stages of the cricket [preadult (nymphal) cricket] [hatching eggs (nymphs) for [180 days] [26 weeks] [6 months]]." Based on the risk profile as described above, **EFED recommends that the label be amended to include an enforceable minimum application interval consistent with the proposed labelled efficacy claims.** This minimal application interval would limit the annual usage of the pesticide and reduce potential toxicity to sensitive organisms.

***Exposure and Risk Conclusions* - MOSQUIRON™ 0.12 P & MOSQUIRON™ 0.12 CRD**

At the highest application rates, the calculated surface water environmental concentrations for MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD within the contained small water bodies exceeded the limit of solubility; therefore, the limit of solubility of 3 µg/L is used as the peak, 21-day and 60 day EECs.

MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD labels restrict application to sites that do not drain into natural water bodies. The ecosystem at immediate risk from

the control of mosquito larvae would be the treated area. For certain proposed uses, it is assumed that there is negligible transport of novaluron from the site of application based on the scale of use or the assumption that the potential pathway to natural waterbodies is incomplete (*e.g.* landfill); these uses include:

- tree holes
- bird baths
- landfills
- flooded roof tops
- abandoned swimming pools
- rain barrels
- gutters
- waste water treatment facilities
- abandoned vehicles
- water holding receptables (*e.g.* tires, urns, flower pots, cans & other containers)
- potable water containers for both humans and animals

For the remaining uses, EFED cannot preclude a potentially complete exposure pathway to natural water bodies based on ambiguity in the use site (*e.g.* sewers) and/or on the implicit nature of the use sites' connection with natural water bodies (*e.g.* ditch). **EFED recommends the following labeled use sites be accompanied by modifiers or other descriptive language that clearly identifies them as sites known not to drain into a natural waterbody (*e.g.* "*closed*" sewer). EFED also recommends label language that clarifies that the following use sites should not drain into combined sewer overflow systems.** The proposed remaining uses are as follows:

- sewers
- uncultivated agriculture and non-agricultural non-food areas
- dredging spoil sites
- drainage areas
- ditches
- sewage effluent
- retention ponds
- harvested timber stacks
- swales
- storm water drainage areas
- catch basins
- junk yards
- dairy or poultry lagoons
- other animal waste lagoons
- livestock runoff lagoons
- other natural and manmade depressions

For those proposed mosquito larvae uses with an incomplete exposure pathway to natural water bodies, fish are not expected to be exposed to novaluron; however, fish serve as a

surrogate for aquatic-phased herpetafauna. Acute and chronic risks to freshwater-dwelling herpetafauna, based on fish toxicity data, are not expected. **Freshwater invertebrates are expected to be exposed to novaluron treatments in small, contained water bodies, and both pelagic and benthic invertebrates are at risk from the proposed novaluron uses up to novaluron's solubility limit.** At the limit of solubility, all aquatic plant RQs were below the LOC and adverse effects to plants are not expected.

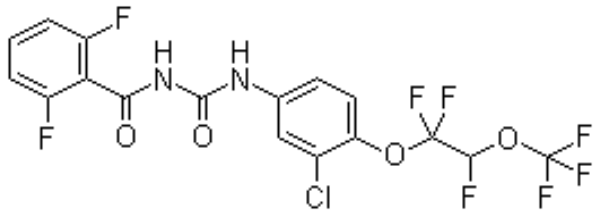
For those proposed mosquito larvae uses where a complete exposure pathway to natural water bodies cannot be precluded, risk to these natural water bodies cannot be assessed quantitatively. Instead, it can be concluded from a qualitative assessment of risk that risk to organisms in a natural water would be equal to or less than the risk posed by novaluron to organisms located in the treated areas. Risk to fish (and species for which fish serve as a surrogate) and aquatic plants are not expected. **Adverse effects to freshwater and estuarine/marine invertebrates is presumed. However, as opposed to the localized concern in the treated water body, the concern for natural water bodies exposed to novaluron is the potential for large scale aquatic ecosystem direct and indirect effects at multiple levels of the trophic system.**

Risks to birds and mammals from the proposed pellet and rod novaluron products are expected to be low. The proposed pellets/rods are composed primarily of wax, which are anticipated to be unappealing to terrestrial wildlife as a dietary item or dietary aid (*i.e.* grit used by birds to grind food). Further, acute dietary effects to birds and mammals are not expected based on acute toxicity data. Thus, risk from incidental consumption is discountable. Terrestrial plants and terrestrial invertebrates are presumed to have negligible exposure to the pellet/rod applications and adverse effects to these taxa are expected to be minimal.

The following six toxicity studies are being requested as a result of the conclusions of this ecological risk assessment. A detailed description of the data gaps is presented on page 11 of the Executive Summary.

1. **Tier I Terrestrial Plant Toxicity Study on Seedling Emergence (850.4100)**
2. **Tier I Terrestrial Plant Toxicity Study on Vegetative Vigor (850.4150)**
3. **Avian Oral Toxicity (850.2100)**
4. **Estuarine/Marine Fish Early Life-Stage Test (850.1400)**
5. **Field Test for Pollinators (850.3040)**
6. **Aquatic Invertebrate Life Cycle Test (850.1300)**

Environmental Fate and Ecological Risk Assessment for the New Uses of Novaluron for Control of Crickets, and Mosquito Larvae



(ChemBlink, 2011)

ASSOCIATED BARCODES:
D385667, D387408, and D387407

Team Members

Alicia Korol, Biologist
Robert A. Miller, Chemist

Peer Reviewers

Dr. Sujatha Sankula, Lead Biologist
Dr. Stephen Wente, Biologist

Date of Approval

May 23, 2011

Table of Contents

1. EXECUTIVE SUMMARY

1.1 Summary of Regulatory Action

The proposed Section 3 registrations include the new use of novaluron, as formulated in RIMON® SUPRA 10EC Insecticide (EPA Reg. No. 66222-ERT, 9.3% a.i.), for the indoor and outdoor control of crickets. The outdoor uses relevant to the ecological risk assessment include perimeter treatments of buildings (*e.g.* building foundation, doors and window frames), and spot treatments, defined as bases of trees, tree holes, mulched areas, and other locations where insects may harbor (*e.g.* garbage areas). RIMON® SUPRA 10EC is formulated as a diluted (emulsifiable concentration) liquid to be applied via a low-pressure sprayer tank at a maximum rate of 1.2 oz of finished spray, or 0.000188 lbs a.i., per sq. yard.

The second proposed Section 3 registration of novaluron is for the control of mosquito larvae in contained, small water bodies, as formulated in MOSQUIRON™ 0.12 P (EPA Reg. No. 66222-EGR ,0.12% a.i.) and MOSQUIRON™ 0.12 CRD (EPA Reg. No. 66222-EGE, 0.12% a.i.). MOSQUIRON™ 0.12% P and MOSQUIRON™ 0.12% CRD products, formulated as pellets and control rods, respectively, are to be applied to small standing bodies of water which support mosquito larval development, or to dry areas prior to flooding. The proposed labels prohibit application of novaluron to pooled water that drains into natural water bodies; however, EFED cannot preclude a complete exposure pathway to aquatic ecosystems for certain proposed use sites (see **Section 2.4** for complete listing). The labels specify that re-treatment should occur every 90 days. Based on labeled application rates, novaluron concentrations in treated water bodies will reach saturation (3 ppm).

Novaluron is a non-systemic benzoylphenyl urea insect growth regulating insecticide that inhibits chitin biosynthesis and interferes in cuticle formation in developing insects belonging to the orders Lepidoptera, Coleoptera, Herniptera, and Diptera. Novaluron has no effect on adult insects that have completed all successive molts.

1.2 Conclusions of Exposure Characterization

Novaluron’s low water solubility and high soil adsorption coefficient indicate novaluron will strongly adsorp to soil and have limited ability to leach into groundwater. Novaluron's major route of degradation is microbial degradation. Aerobic soil and aqueous degradation half-lives range from 7-32 days and 10-51 days, respectively. Novaluron is stable to hydrolysis, aqueous photolysis, and soil photodegradation. The high lipophilicity (log Kow of 4.3) of novaluron suggests that it has a tendency to bioaccumulate.

EFED calculated a maximum application rate of 0.91 a.i. lbs/A (1.02 kg/ha) from the proposed RIMON® SUPRA 10EC product label for outdoor perimeter and spot treatments. Estimated Environmental Concentrations (EECs) in surface water were calculated for RIMON® SUPRA 10EC outdoor perimeter and spot treatments using the

Tier II PRZM and EXAMS models. PRZM/EXAMS is based on a standard scenario in which a ten-hectare watershed is completely treated and drains into a one-hectare pond. This model was used to generate EECs for outdoor perimeter and spot treatments with the conservative, but realistic, assumption that a 10 hectare development such as a retirement community or town home association, in which pesticide spraying is conducted under the auspices of a single landscape maintenance program, is applied with RIMON® SUPRA 10EC on a single day. However, Rimon is unlikely to be applied to an entire 10 hectare surface area at a single application (including ground and building applications). Therefore, EFED modeled the outdoor perimeter and spot treatment use of novaluron at 1.0, 5.0 10, 25, and 100% of the assumed watershed (10 hectare) to bound the aquatic environmental exposure at estimated high and low use rates. For terrestrial exposure, the maximum use rate per acre (0.91 lbs a.i./A) was modeled.

For example, the peak EECs for 10% of the treated 10 hectare watershed ranged from 0.09 µg/L (PA Turf) to 0.001 µg/L (CA Turf RLF), with a median of 0.04 µg/L. The 21-day EECs ranged from 0.03 µg/L (PA Turf) to 0.0007 µg/L (CA Turf RLF), with a median of 0.015 µg/L. The predicted 60-day average EECs ranged from 0.01 (PA Turf) µg/L to 0.0004µg/L (CA Turf RLF), with a median of 0.007 µg/L for all scenarios modeled.

At the highest application rates, the calculated surface water environmental concentrations for MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD within the contained small water bodies exceeded the limit of solubility; therefore, the limit of solubility of 3 µg/L is used as the peak, 21-day and 60 day EECs. For those proposed mosquito larvae uses where a complete exposure pathway to natural water bodies cannot be precluded, the magnitude of runoff from the treated water body into natural ecosystems cannot be modeled quantitatively; however, it can be conservatively assumed that concentrations at the point of discharge into a natural water body are equal to or less than the concentrations in the treated water body.

Chlorophenyl urea and chloroaniline are novaluron metabolites of concern identified by the Health Effects Division (HED) for drinking water concern (MARC, 2004). Chlorophenyl urea is less of a concern to aquatic organisms than novaluron based on chlorophenyl urea's and novaluron's low solubility limits relative to toxicity endpoints. Therefore, risk of chlorophenyl urea toxicity to aquatic organisms will not be assessed and current risk analysis is based on the parent alone; however, risk to terrestrial organisms will be assessed where data are available (*i.e.* terrestrial invertebrates). Environmental exposure and risk quotients were not calculated for chloroaniline because there are limited fate data and no terrestrial or aquatic ecotoxicity and/or toxicity data available.

1.3 Potential Risks to Non-target Organisms

Proposed Use on Crickets

Due to novaluron's low solubility limit, acute risks to freshwater and estuarine/marine

fish and chronic risk to freshwater fish are not expected; chronic risk to estuarine/marine fish are presumed due to lack of data. Chronic toxicity endpoints were used to derive risk quotients (acute/chronic) for aquatic invertebrates due to novaluron's mode of action (as discussed in the Risk Estimation Section, 6.1). There is the potential for adverse effects to aquatic freshwater and estuarine/marine invertebrates at applications to treated areas equal to or greater than 10% of the modeled 10 hectare watershed. At the limit of solubility, all aquatic plant RQs were below the LOC and adverse effects to plants are not expected.

Acute risk from dietary exposure to novaluron is not expected for birds or mammals based on acute toxicity data; however no data exists on passeriforms, a potentially more sensitive taxon than the surrogate species tested, and thus acute risk to birds is presumed. Chronic adverse effects to birds are expected for all herbivorous, insectivorous, and granivorous birds (dietary RQs ranged from 1.39-22.3). Chronic adverse effects from dietary exposures are also expected to mammals based on LOC exceedances (does-based RQs $\leq$ 1.28). There is the potential for adverse effects to beneficial insects (*i.e.* pollinators) because application to flowering plants is not prohibited. Adverse effects to all terrestrial invertebrates from chlorophenyl urea toxicity are presumed. Risks of novaluron toxicity to terrestrial plants are presumed due to lack of data.

Proposed Use on Mosquito Larvae

For those proposed mosquito larvae uses with an incomplete exposure pathway to natural water bodies, fish are not expected to be exposed to novaluron; however, fish serve as a surrogate for aquatic-phased herpetafauna. Acute and chronic risks to freshwater-dwelling herpetafauna, based on fish toxicity data, are not expected. Freshwater invertebrates are expected to be exposed to novaluron treatments in small, contained water bodies, and both pelagic and benthic invertebrates are at risk from the proposed novaluron uses up to novaluron's solubility limit. At the limit of solubility, all aquatic plant RQs were below the LOC and adverse effects to plants are not expected.

For those proposed mosquito larvae uses where a complete exposure pathway to natural water bodies cannot be precluded, risk to these natural water bodies cannot be assessed quantitatively. Instead, it can be concluded from a qualitative assessment of risk that risk to organisms in a natural water would be no greater than the risk posed by novaluron to organisms located in the treated areas. Risk to fish (and species for which fish serve as a surrogate) and aquatic plants are not expected. Adverse effects to freshwater and estuarine/marine invertebrates is presumed. However, as opposed to the localized concern in the treated water body, the concern for natural water bodies exposed to novaluron is the potential for large scale aquatic ecosystem direct and indirect effects at multiple levels of the trophic system.

Risks to birds and mammals from the proposed pellet and rod novaluron products are expected to be low. The proposed pellets/rods are composed primarily of wax, which are anticipated to be unappealing to terrestrial wildlife as a dietary item or dietary aid (*i.e.* grit used by birds to grind food). Further, acute dietary effects to birds and mammals are

not expected based on acute toxicity data. Thus, risk from incidental consumption is discountable. Terrestrial plants and terrestrial invertebrates are presumed to have negligible exposure to the pellet/rod applications and adverse effects to these taxa are expected to be minimal.

Bioaccumulation Assessment

All RQs for birds and mammals that consume aquatic organisms are below concern levels at novaluron's solubility limit. Therefore, although the BCF value of novaluron is consistent with highly bioaccumulative chemicals, it does not appear that risk exceeds concern levels to non-target birds or mammals that consume contaminated aquatic organisms.

Threatened and Endangered Species

Federally listed species co-located in states, districts, or commonwealths, known to produce the crops upon which the pesticide will be used were identified using the LOCATES database (query performed on 4/11/11). Species on which direct and indirect effects may occur due to the proposed new uses are presented in **Appendix G** and summarized by taxa in the following **Table 1**.

Table 1. Listed Species Risks Associated with the Proposed New Uses of Novaluron

Listed Taxa	Direct Effects	Indirect Effects
Terrestrial and semi-aquatic plants – monocots	**Yes**[1]	**Yes**
Terrestrial and semi-aquatic plants – dicots	**Yes**[1]	**Yes**
Birds	**Yes**	**Yes**
Terrestrial phase amphibians	**Yes**	**Yes**
Reptiles	**Yes**	**Yes**
Mammals	**Yes**	**Yes**
Terrestrial insects	**Yes**	**Yes**
Aquatic plants	No	**Yes**
Freshwater fish	No	**Yes**
Aquatic phase amphibians	No	**Yes**
Freshwater invertebrates	**Yes**	**Yes**
Mollusks	**Yes**	**Yes**
Marine/estuarine fish	**Yes**[1]	**Yes**
Marine/estuarine invertebrates	**Yes**	**Yes**

[1] Risk to taxon based on direct effects is presumed due to lack of data.

1.4 Key Data Gaps and Uncertainties

Data gaps

- **Tier I Terrestrial Plant Toxicity Study on Seedling Emergence (850.4100):** Since novaluron is proposed for outdoor use, a seedling emergence study is required on terrestrial plants. It is noted that this product has been previously registered on ornamentals, pome fruit, cotton, potato, head and stem brassica, tomato, sugarcane, stone fruit, bushberry, brassica leafy greens, turnip greens, sorghum, fruiting and curcurbit vegetables, low growing berries, snap and dry bean, swiss chard, and sweet corn, and novaluron may not be lethal to many plants up to the previously registered application rates. However, effects on terrestrial plant growth (height and dry weight) and toxicity to listed species are unknown. Further, because the proposed spray applications are not limited on a spatial or temporal scale, adverse effects to terrestrial plants are presumed from the proposed RIMON® SUPRA 10EC applications. A Tier I terrestrial plant toxicity study should be conducted at the maximum labeled rate for novaluron (0.91 lbs a.i./A).

- **2. Tier I Terrestrial Plant Toxicity Study on Vegetative Vigor (850.4150):** Since novaluron is proposed for outdoor use, a vegetative vigor study is required on terrestrial plants. It is noted that this product has been previously registered on ornamentals, pome fruit, cotton, potato, head and stem brassica, tomato, sugarcane, stone fruit, bushberry, brassica leafy greens, turnip greens, sorghum, fruiting and curcurbit vegetables, low growing berries, snap and dry bean, swiss chard, and sweet corn, and novaluron may not be lethal to many plants up to the previously registered application rates. However, effects on terrestrial plant growth (height and dry weight) and toxicity to listed species are unknown. Further, because the proposed spray applications are not limited on a spatial or temporal scale, adverse effects to terrestrial plants are presumed from the proposed Rimon 10EC applications. A Tier I terrestrial plant toxicity study should be conducted at the maximum labeled rate for novaluron (0.91 lbs a.i./A).

- **3. Avian Oral Toxicity (850.2100)** Avian acute oral toxicity data are not available for a passerine species, which are required under the new 40 CFR Part 158. Toxicity data on passerines may indicate that risks to passerine species are underestimated in this risk assessment.

- **4. Estuarine/Marine Fish Early Life-Stage Test (850.1400)** Due to novaluron's persistence in the water, aerobic aquatic metabolism half-lives ranged 9.7-19.7 days, chronic toxicity data of novaluron exposure is required on estuarine/marine fish. Risk to this taxon will be presumed in the absence of data.

- **5. Field Test for Pollinators (850.3040**) Previous ecological risk assessments for proposed new uses of novaluron identified a field test for pollinators as a data gap because the toxicity of novaluron on hive viability was not assessed up to the

labeled maximum application rate and was not tested on a crop registered or proposed for use in the United States. In concurrence with the Office of Pesticide Programs, the registrant agreed to modify label language in lieu of conducting a field study: improve pollinator advisory and remove label statements that allow novaluron to be sprayed on blooms (DP 383269). EFED is still waiting to review the label amendment. Because the RIMON® SUPRA 10EC Insecticide label does not limit the spatial or temporal application of novaluron on spray applications of crickets, a field study for pollinators is also a data gap for this risk assessment. However, protective label language that prohibits applications to blooming flowers would obviate the need for a field study.

- **6. Aquatic Invertebrate Life Cycle Test (850.1300)** This study is needed for both degradates of concern, chlorophenyl urea and chloroanaline. Based on previous assessments, toxicity data on chlorophenyl urea indicate that the degradate is in some cases more toxic to certain taxa than the parent novaluron. However, a direct comparison between the toxicity of the parent and chlorophenyl urea on the developmental effects to aquatic invertebrates (a stage very sensitive to parent novaluron) cannot be made. For chloroanaline, no ecotoxicity data is available to make a comparison of toxicity with the parent. Aquatic invertebrate life cycle tests will help establish a baseline comparison of the relative toxicities between novaluron and both degradates.

Uncertainties

The California turf (CA Turf RLF) and California residential (CA Res RLF) California Red-legged Frog scenarios were used to model novaluron turf and residential uses. The extent to which the CA Turf RLF and CA Res RLF scenarios provide representative EECs as compared to standard PRZM/EXAMS scenarios is uncertain.

The proposed RIMON® SUPRA 10EC label does not restrict the number of annual applicatons for outdoor perimeter treatments; therefore, EFED assessed the single maximum application rate because the yearly maximum application rate is not specified.

2. PROBLEM FORMULATION

The purpose of this problem formulation is to provide the foundation for the ecological risk assessment being conducted for the proposed new uses of the insecticide novaluron. As such, it articulates the purpose and objectives of the risk assessment, evaluates the nature of the problem, and provides a plan for analyzing the data and characterizing risk (US EPA 1998).

2.1 Nature of Regulatory Action

The proposed Section 3 registrations include the new use of novaluron, as formulated in RIMON® SUPRA 10EC Insecticide (9.3% a.i.), for the indoor and outdoor control of roaches and crickets. The outdoor uses relevant to the ecological risk assessment include

perimeter treatments of buildings (*e.g.* building perimeter and foundation, doors and window frames), and spot treatments, defined as bases of trees, tree holes, mulched areas, and other locations where insects may harbor (*e.g.* garbage areas). RIMON® SUPRA 10EC is formulated as a diluted (emulsifiable concentration) liquid to be applied via a low-pressure sprayer tank at a maximum rate of 1.2 oz of finished spray, or 0.000188 lbs a.i., per sq. yard. The RIMON® SUPRA 10EC label neither states the maximum number of applicatons for outdoor uses nor the possible minimum application interval.

The second proposed Section 3 registration of novaluron is for the control of mosquito larvae in contained, small water bodies, as formulated in MOSQUIRON™ 0.12 P (0.12% a.i.) and MOSQUIRON™ 0.12 CRD (0.12% a.i.). MOSQUIRON™ 0.12% P and MOSQUIRON™ 0.12% CRD products, formulated as pellets and control rods, respectively, are to be applied to small standing bodies of water which support mosquito larval development, or to dry areas prior to flooding. The proposed labels prohibit application of novaluron to pooled water that drains into natural water bodies. The labels specify that re-treatment should occur every 90 days. Based on labeled application rates, novaluron concentrations in treated water bodies will reach saturation (3 ppm).

2.2 Stressor Source and Distribution

2.2.1 Nature of Chemical Stressor

Novaluron is an insect growth regulating insecticide in the benzoylphenyl urea family which acts on the target pest larval stage by inhibiting chitin biosynthesis blocking cuticle formation. Novaluron is a chiral compound containing a racemic mixture of two enantiomers (R,S). The available environmental fate and ecological effects data on novaluron represents only the racemic mixture. **Figure 1** shows the molecular structure of novaluron.

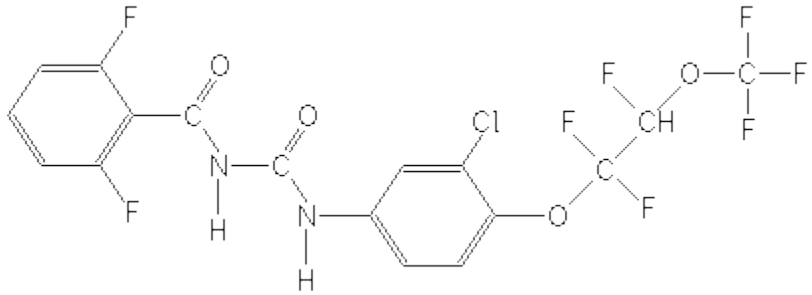


Figure 1. Chemical structure of novaluron.

Novaluron has low vapor pressure (1.2×10^{-7} mm Hg), low water solubility (3 ppb), and high soil adsorption coefficient (K_{oc} = 6,680 - 11,813). The low water solubility plus high soil adsorption coefficient indicates novaluron's strong adsorption to soil and its limited ability to leach into groundwater.

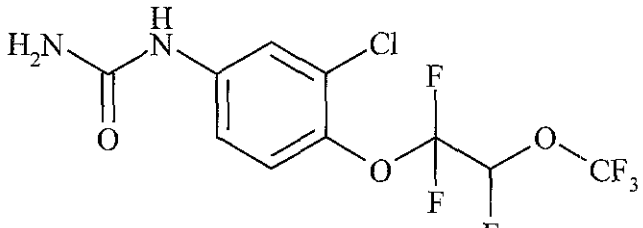
Novaluron's major route of degradation is microbial degradation. Soil and aqueous degradation half-lives range from 7-32 days and 10-51 days, respectively. Novaluron is stable to hydrolysis ($T_{1/2}$ = 101 days) and soil photodegradation ($T_{1/2}$ = 257 days) and aqueous photolysis ($T_{1/2}$ = 187 days).

The high lipophilicity (log Kow of 4.3) of novaluron suggests that it has a tendency to bioaccumulate. A bioconcentration study using bluegill sunfish reported the highest mean bioconcentration factor in whole fish of 14,431. The physical and chemical properties of novaluron are listed in **Table 1**.

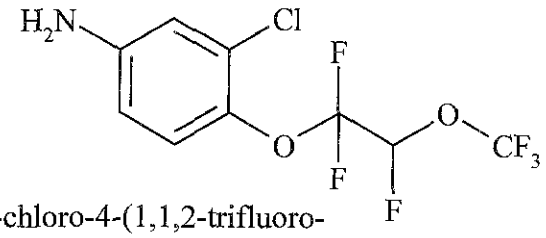
Table 1. Physical-chemical Properties of Novaluron		
Parameter	**Value**	**Reference**
Common Name	Novaluron	
Chemical Name (IUPAC)	(RS)-1-[3-Chloro-4 (1,1,2-trifluoromethoxyethoxy)phenyl]-3-(2,6-difluorobenzoy1)urea	Product Chemistry
Molecular Weight	492.7	Product Chemistry
Molecular Formula	$C_{17}H_9ClF_8N_20_4$	Product Chemistry
Vapor Pressure	1.2 X 10^{-7} mm Hg	Product Chemistry
Octanol/water Partition Coefficient (Kow)	4.3	MRID 45638405
Water Solubility	3 µg/L @ 25º C	Product Chemistry
Henry's Law Constant	2.0 Pa m^3/mol^{-1}	Calculated from vapor pressure and water solubility.

Degradates

Chlorophenyl urea and chloroaniline are novaluron metabolites identified by the Health Effects Division (HED) to be of human drinking water concern (MARC, 2004). The chloroaniline moiety, thought to be associated with the most pronounced toxicological effects of novaluron, is conserved in both metabolites. **Figure 2** shows the molecular structures of chlorophenyl urea and chloroaniline.



1-[3-chloro-4-(1,1,2-trifluoro-2-trifluoromethoxyhethoxy)-phenyl] urea (275-352I)



3-chloro-4-(1,1,2-trifluoro-2-trifluoromethoxyhethoxy) aniline (275-309I)

Figure 2. Chemical structure of chlorophenyl urea and chloroaniline

Chlorophenyl urea (275-3521) occurred in aerobic soil metabolism at the maximum of 26.6% of the applied parent at 7 days post treatment. Based on the McCall et al., 1980 classification system the chlorophenyl urea appears to have low to slight mobility in soil (K_{oc} values range from 1,950 to 2,563). Comparisons of toxicity data (DP 340579+) show that chlorophenyl urea is orders of magnitude less toxic to aquatic invertebrates. Based on a review of the previously assessed toxicity (**Appendix A**) and fate data for chlorophenyl urea, chlorophenyl urea is less of a concern to aquatic organisms than novaluron based on chlorophenyl urea's and novaluron's low solubility limits relative to toxicity endpoints. Therefore, risk of chlorophenyl urea toxicity to aquatic organisms will not be assessed; however, risk to terrestrial organisms will be assessed where data are available (*i.e.* terrestrial invertebrates).

Chloroaniline occurred at a maximum of 8.5% of applied in the aerobic soil metabolism study at 120 days posttreatment, the last sampling interval (MRID 44961009). Additionally, it is expected that chloroaniline is formed from the further degradation of the major degradate, chlorophenyl urea (275-352I) (MRIDs: 45638205 and 45789203). In the anaerobic aquatic metabolism study, at the last sampling interval, i.e., 363 days posttreatment, the maximum of 32% of the applied occurred in the soil and 49.8% in the total system. This includes soil and volatilized chloroaniline. Chloroaniline has the potential to be volatile (i.e., its estimated vapor pressure exceeds 10^{-4} mmHg), more mobile (K_{oc} (an estimated value) = 5,899) and more persistent than the parent. Degradation rates for chloroaniline could not be calculated due to the lack of formation and decline data. No ecotoxicity data is available on chloroanaline; chloroanaline is not further considered in this ecological risk assessment.

The physical and chemical properties of chlorophenyl urea and chloroaniline are listed in **Table 2**.

Table 2. Physical-chemical Properties of Chlorophenyl Urea and Chloroaniline

Parameter	Value	Reference
Chlorophenyl Urea		
Molecular Weight	352.6 g/mole	Product Chemistry
Water Solubility	33 ppm	Product Chemistry
Chloroaniline		
Molecular Weight	310.6 g/mole	Product Chemistry
Water Solubility	10.6 ppm	Product Chemistry

2.2.2 Mode of Action

Novaluron is a non-systemic benzoylphenyl urea insect growth regulating insecticide that inhibits chitin biosynthesis and interferes in cuticle formation in insects belonging to the orders Lepidoptera, Coleoptera, Herniptera, and Diptera. Novaluron mediated disruption of cuticle development in insects leads to abnormal endocuticular deposition, abortive molting, and adverse effects on insect growth and development. Novaluron acts primarily by ingestion, but also has some contact activity. Novaluron has no effect on adult insects that have completed all successive molts.

2.2.3 Proposed Uses

Proposed Section 3 novaluron uses are formulated under three new product labels as presented in **Table 3.** Proposed indoor uses of Rimon Supra 10 EC are not expected to result in significant ecological exposure because indoor uses have limited pathways for outdoor exposure; and therefore, are not evaluated in this assessment. The proposed outdoor uses are relevant to this ecological risk assessment.

Table 3. Proposed New Uses for Novaluron

Product	Targeted Areas	Target Insects
RIMON® SUPRA 10EC Insecticide	Outdoor uses: outdoor perimeter and spray spot treatments around garbage areas, tree bases, tree holes, mulched beds, and other areas harboring insects. Indoor uses: spot and crack and crevice, warehouses, food handling establishments (food and non-food areas), spray and general surface application (when facility is not in operation or when food is covered) and stored food warehouses.	Crickets
MOSQUIRON™ 0.12 P	Outdoor uses: Wet areas including uncultivated agricultural and non-agricultural non-food areas, dredging soil sites, drainage areas, ditches, waste water treatment facilities, dairy or poultry lagoons, other animal waste lagoons, livestock run-off lagoons, sewage effluent, retention ponds, harvested timber stacks, swales, storm water drainage areas, sewers, catch basins, tree holes, bird baths, landfills, rain barrels, flooded rooftops, abandoned swimming pools, gutters, junk abandoned vehicles, water holding receptacles, (*e.g.*, tires, urns, flower pots, cans, & other containers) and other natural and manmade depressions; Dry areas prior to flooding	Mosquito larvae in small water bodies
MOSQUIRON™ 0.12 CRD		

The proposed Rimon Supra 10EC label specifies an application rate of 1.2 oz of finished spray per square yard of treated area. The finished spray is prepared by adding the maximum of 3.1 ounces per gallon of water:

Given that there are 4,840 square yards in an acre, if an entire acre were treated at the specified application rate the total application would be 0.91 lbs a.i./A (1.02 kg/ha).

The RIMON® SUPRA 10EC label neither restricts the number of applicatons for outdoor perimeter and spot treatments nor mentions the possible minimum application interval. The RIMON® SUPRA 10EC label does not restrict the number of annual applications. In the Indoor and Outdoor Applications section on the RIMON® SUPRA 10EC product

label it is stated that RIMON® SUPRA 10EC "inhibits the development of the immature stages of the cricket [preadult (nymphal) cricket] [hatching eggs (nymphs) for [180 days] [26 weeks] [6 months]]." EFED assessed a single maximum application rate because a yearly maximum application rate is not specified. Based on the fate and persistence of novaluron, a second application roughly six months later would not appreciably alter the EECs nor the risk conclusions of this assessment. EFED assessed the perimeter and spot treatment uses of novaluron at 1.0, 5.0, 10, 25, and 100% of a 10 hectare watershed to investigate aquatic exposure and risk at various scales. For terrestrial exposure, the maximum application rate (0.091 lbs ai/A) was modeled.

MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD are formulated into hard, wax pellets and "rods" (large solid pellets), respectively, for placement in containers of water, wet areas, and dry areas prior to flooding, which must not drain into natural water bodies, that may harbor mosquito larvae. The wax formulations disintegrate slowly and absorb to the area being treated, retaining effectiveness through multiple wetting and drying events; the labels direct re-treatment every 90 days. Based on labeled application rates, novaluron concentrations in treated water bodies will reach saturation (3 ppm) and stay saturated until the pellets or rods have completely disintegrated.

2.3 Previous Environmental Fate and Ecological Effects Risk Assessments

Novaluron has previously been registered via six labels for nation-wide insecticidal use on ornamentals plants, pome fruit, cotton, potato, head and stem brassica, tomato, sugarcane, stone fruit, bushberry, brassica leafy greens, turnip greens, sorghum, fruiting and curcurbit vegetables, low grow berries (crop subgroup), snap and dry bean, Swiss chard, and sweet corn.[1] Emergency use exemptions of the insecticide have been approved for use on strawberry in Florida and California.[2] The single maximum application rates for these uses range from 0.078 to 0.32 lbs a.i./A, with the highest maximum annual application rate of 0.972 lbs a.i./A registered for stone fruit.

Previous risk assessments in support of these registrations have determined that for some novaluron uses, there are potential adverse direct effects to aquatic invertebrates, mammals and birds (on a chronic basis), terrestrial insects, and terrestrial plants (presumed due to lack of data). A comprehensive list of previous environmental fate and ecological risk assessments for novaluron is found in **Appendix B**.

In a risk assessment dated November 27th, 2009 (DP364309 and DP364313), novaluron was determined to meet the classification criteria for a persistent, bioaccumulative, and toxic chemical, although certain properties of novaluron mitigate its ecological risk (*e.g.* persistence of novaluron is <60 days is most environments). A bioaccumulation assessment evaluated the potential for novaluron bioaccumulation in aquatic organisms to affect birds and mammals that consume contaminated aquatic prey. The assessment was

[1] These actions are associated with the following DP Barcodes: 318619, 285499, 285479, 287624, 297230, 321545, 358376, 364309, 364313, and 378620.

[2] These actions are associated with the DP barcodes 357484 and 364391.

performed using the KABAM model (version 1.0, April 2009) and did not identify potential risks at the Agency's Levels of Concern to birds or mammals that consume aquatic organisms.

2.4 Ecosystems Potentially at Risk

The ecosystems at risk are often extensive in scope, and as a result it may not be possible to identify specific ecosystems during the development of a baseline risk assessment. However, in general terms, terrestrial ecosystems potentially at risk from the proposed RIMON® SUPRA 10EC label to control of crickets could include the area treated and naturalized sites immediately adjacent to the treated area that may receive runoff. Spray drift as a result of the application of RIMON® SUPRA 10EC via a low pressure sprayer is expected to be negligible. Terrestrial areas adjacent to the treated site could include cultivated fields, fencerows and hedgerows, meadows, fallow fields or grasslands, woodlands, riparian habitats and other uncultivated areas. Aquatic ecosystems potentially at risk from applications to control crickets include water bodies adjacent to, or down stream from, the treated area and might include impounded bodies such as ponds, lakes and reservoirs, or flowing waterways such as streams or rivers. For uses in coastal areas, aquatic habitat also includes marine ecosystems, including estuaries.

MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD labels restrict application to sites that do not drain into natural water bodies. The ecosystem at immediate risk from the control of mosquito larvae would be the treated area. For certain proposed uses, it is assumed that there is negligible transport of novaluron from the site of application based on the scale of use or the assumption that the potential pathway to natural waterbodies is incomplete (*e.g.* landfill); these uses include tree holes, bird baths, landfills, flooded roof tops, abandoned swimming pools, rain barrels, gutters, waste water treatment facilities, abandoned vehicles, water holding receptables (*e.g.* tires, urns, flower pots, cans & other containers), and potable water containers for both humans and animals. For the remaining uses, EFED cannot preclude a potentially complete exposure pathway to natural water bodies based on ambiguity in the use site (*e.g.* sewers) and/or on the implicit nature of the use sites' connection with natural water bodies (*e.g.* ditches); these proposed use sites include sewers, uncultivated agriculture and non-agricultural non-food areas, dedging spoil sites, drainage areas, ditches, sewage effluent, retention ponds, harvested timber stacks, swales, storm water drainage areas, catch basins, junk yards, dairy or poultry lagoons, other animal waste lagoons, livestock runoff lagoons, and other natural and manmade depressions.

As an example of a complete exposure pathway, Angelune Des Lauriers *et al*. (2006) evaluated concentrations of the biopesticide methoprene for mosquito larvae control in treated catch basins, areas receiving outflow from storm drainage systems. The study also evaluated the concentration of methroprene in water flushed out of the catch basins via a storm sewer outfall into the immediate watershed. This study found detectable concentrations of methoprene in the storm sewer outfall, demonstrating that at least for the proposed novaluron use in catch basins, there is a potentially complete exposure pathway to natural waterbodies. It also suggests that novaluron concentrations in water

running out the treated area may be high enough to cause adverse effects in aquatic ecosystems. Natural water bodies are at potential risk from some of the proposed novaluron uses to control mosquito larvae; however, risk to these natural water bodies cannot be assessed quantitatively. Risk to the ecosystem directly treated with novaluron will be assessed quantitatively.

2.5 Assessment Endpoints

Assessment endpoints represent the actual environmental value that is to be protected, defined by an ecological entity (species, community, or other entity) and its attribute or characteristics (EPA, 1998). For novaluron, the ecological entities may include the following: birds, mammals, freshwater fish and invertebrates, estuarine/marine fish and invertebrates, terrestrial plants, insects, and aquatic plants and algae. Birds are used as surrogates for reptiles and terrestrial-phase amphibians and freshwater fish are used as surrogates for aquatic-phase amphibians. The attributes for each of these entities may include growth, reproduction, and survival.

This assessment quantitatively evaluates the potential risk to fish from the proposed novaluron control of mosquito larvae; however, fish are not expected to be present in contained, small water bodies and as such are used as a surrogate for aquatic-phase herpetafauna. Likewise, estuarine/marine invertebrates and terrestrial plants are not expected to be present in areas supporting contained, small water bodies and risks to these taxa are quantitatively assessed for the proposed spray applications of novaluron only.

2.6 Conceptual Model

2.6.1 Risk Hypotheses

For novaluron, the following ecological risk hypotheses are being employed for this baseline risk assessment:

- Terrestrial and aquatic organisms are subject to adverse direct effects such as reduced survival, growth, and reproduction when exposed to novaluron residues as a result of labeled use of the pesticide.

- Non-target terrestrial, semi-aquatic, and aquatic plants are subject to adverse effects such as reductions in vegetative vigor and seedling emergence (terrestrial) or biomass and growth rate (aquatic) when exposed to novaluron residues as a result of labeled use of the pesticide.

- Indirect effects, such as food web dynamics, perturbing forage or prey availability, and altering the extent and nature of nesting, will potentially occur if residue concentrations exceed levels of concern for acute or chronic exposure for terrestrial and/or aquatic species.

- Listed species are subject to adverse effects if calculated risk quotients exceed acute Listed or chronic levels of concern.

2.6.2 Conceptual Diagram

The potential exposure pathways and effects of RIMON® SUPRA 10EC and the MOSQUIRON™ 0.12 formulations in terrestrial and aquatic environments are depicted in **Figure 3**. Solid arrows represent the most likely routes of exposure; dashed lines represent potential routes of exposure that are not considered likely for novaluron.

The source and mechanism of release of novaluron for control of crickets is direct deposition and runoff and/or erosion following rainfall events; spray drift as a result of applications of novaluron via a low pressure sprayer is expected to be negligible. The source and mechanism of release of novaluron for control of mosquito larvae is direct application to the water body. For quantitative assessment, it is assumed that novaluron will be contained at the treated site, a natural or manmade depression in dry or wet conditions, which does not drain into natural water bodies; a qualitative assessment will evaluate novaluron runoff/erosion into natural water bodies from the mosquito larvacide use. The conceptual model and subsequent analysis of exposure and effects are based on novaluron and chlorophenyl urea. Surface water runoff from area of application is assumed to follow topography.

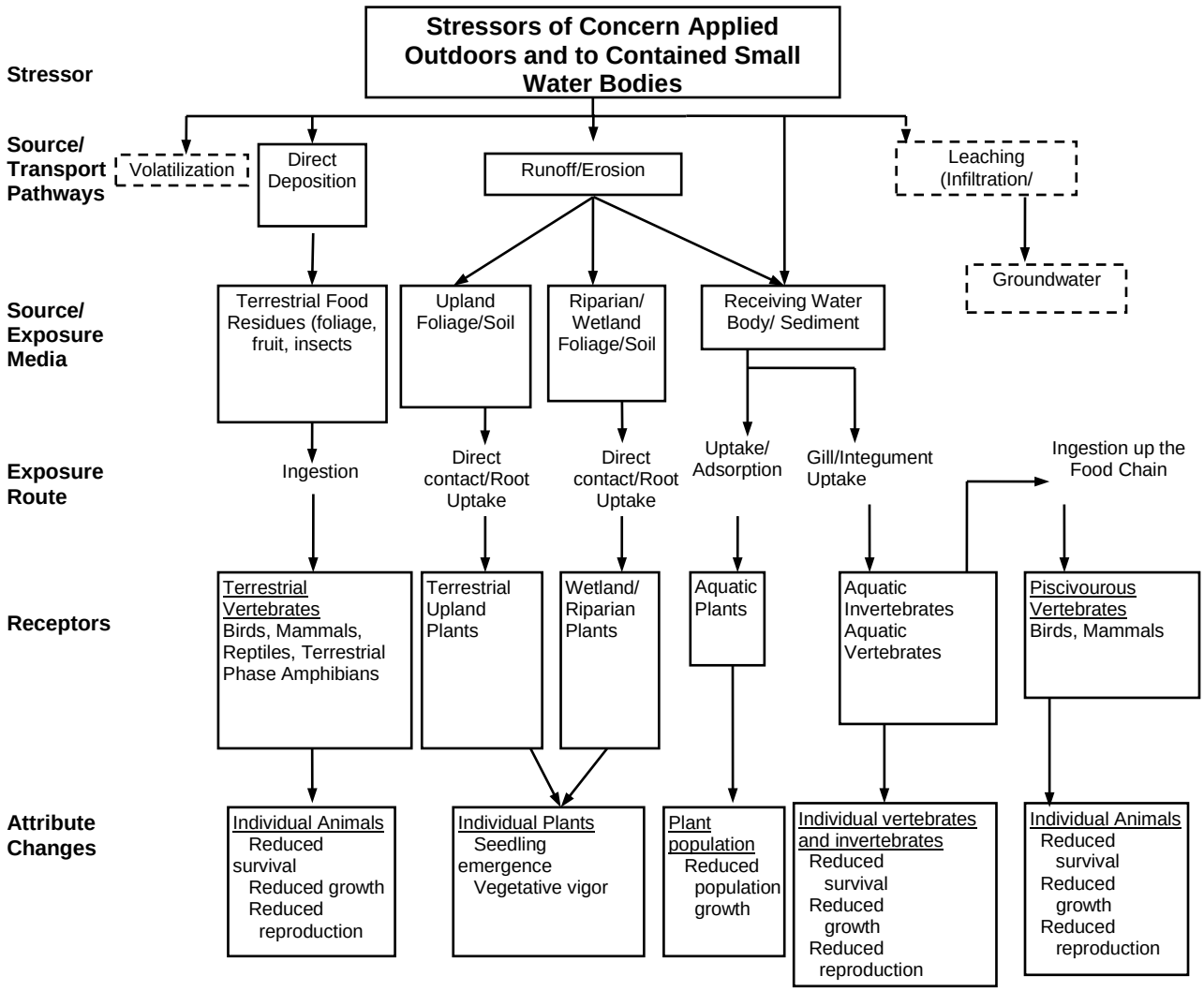


Figure 3. Conceptual model depicting stressors, exposure pathways, and potential effects to terrestrial and aquatic organisms from the use of novaluron.

2.7 Analysis Plan

The analysis plan for the proposed new uses of novaluron outlines the basic components of the baseline risk assessment. This document characterizes the environmental fate of novaluron to assess the extent to which non-target organisms might be exposed through the proposed uses of the insecticide. The toxicity of novaluron is characterized based primarily on registrant-submitted guideline toxicity tests, but includes additional toxicity information from open literature. The majority of open literature is acquired through the Agency's ECOTOX database (http://www.epa.gov/ecotox/). Estimated exposure and effects are integrated to calculate risk quotients (RQs) for non-target endangered/threatened (listed) and non-listed animals and plants. These RQs are compared to pre-determined levels-of-concern (LOCs) to screen out those taxa to which novaluron appears not to pose unacceptable risk (See **Appendix C**). The determination

of which non-target organisms may and may not be at risk from novaluron exposure will be considered under the requirements of FIFRA and ESA.

3. EXPOSURE SUMMARY

3.1 Use Characterization

The proposed Section 3 registrations include the new use of novaluron, as formulated in RIMON® SUPRA 10EC Insecticide (EPA Reg. No. 66222-ERT, 9.3% a.i.), for the indoor and outdoor control of roaches and crickets. The outdoor uses relevant to the ecological risk assessment include perimeter treatments of buildings (*e.g.* building foundation, doors and window frames), and spot treatments, defined as bases of trees, tree holes, mulched areas, and other locations where insects may harbor (*e.g.* garbage areas). The proposed indoor uses of RIMON® SUPRA 10EC occur in enclosed environments and are assumed by EFED to have no complete exposure pathways to ecological receptors; and therefore, are not evaluated in this assessment.

RIMON® SUPRA 10EC is formulated as a diluted (emulsifiable concentration) liquid to be applied via a low-pressure sprayer tank at a maximum rate of 1.2 oz of finished spray, or 0.000188 lbs a.i., per sq. yard (see **Appendix D** for calculation). EFED calculated a maximum application rate of 0.91 a.i. lbs/A (1.02 kg/ha) from the proposed RIMON® SUPRA 10EC product label for outdoor perimeter and spot treatments.

Consistent with EFED's standard scenarios used to model surface water runoff (PRZM and EXAMS models), it is conservatively assumed that a 10 ha watershed is treated with novaluron in a single day. This assumption is realistic when considering the pest management operations for a large retirement community or town home association. However, RIMON® SUPRA 10EC is unlikely to always be applied to an entire 10 ha surface area (including ground and building foundations) for a single application. Therefore, EFED modeled the outdoor perimeter and spot treatment use of novaluron at 1.0, 5.0 10, 25, and 100% of the assumed watershed (10 ha) to bound the environmental exposure to aquatic ecosystems at estimated high and low use rates (**Table 4**). For terrestrial exposure modeling, the maximum use rate per acre (0.91 lbs a.i./A) is modeled assuming more than one acre may be treated with novaluron at one time.

Table 4. One Outdoor Perimeter and Spot Treatment Application (0.000188 lbs a.i./sq. yard) of RIMON® SUPRA 10EC Assessed at Various Percentages of a Treated Hectare for Aquatic Risk Determination

Percent of Watershed Treated	Lbs. a.i./A	Kg/ha
100%	0.91	1.02
25%	0.23	0.26
10%	0.09	0.10
5.0%	0.05	0.056
1.0%	0.01	0.011

The proposed RIMON® SUPRA 10EC label neither states the maximum number of applicatons for outdoor uses nor the possible minimum application interval.

In the Indoor and Outdoor Applications section on the RIMON® SUPRA 10EC product label it is stated that RIMON® SUPRA 10EC "inhibits the development of the immature stages of the cricket [preadult (nymphal) cricket] [hatching eggs (nymphs) for [180 days] [26 weeks] [6 months]]." EFED assessed a single maximum application rate because a yearly maximum application rate is not specified.

The second proposed Section 3 New Use registration is for MOSQUIRON™ 0.12 P (EPA Reg. No. 66222-EGR, 0.12%) and MOSQUIRON™ 0.12 CRD (EPA Reg. No. 66222-EGE, 0.12%) for control of mosquito larvae for up to 90 days in small water bodies that may harbor mosquito larvae, which do not drain into natural water bodies (*e.g.* bird baths, tree holes, and animal waste lagoons). MOSQUIRON™ 0.12 P MOSQUIRON™ 0.12 CRD work only in the larval stages of mosquitoes; therefore, it is best to apply at the beginning of the mosquito season. MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD are to be applied every 90 days.

MOSQUIRON™ 0.12 P is formulated as a 0.2g pellet containing 0.00024 g of novaluron. The MOSQUIRON™ 0.12 P label directs application of 5-10 ounces per 100 sq. ft. of surface area; for a water body of 500 gallons, the label recommends roughly 5 ounces (~150g) of pellets (758 pellets). MOSQUIRON™ 0.12 CRD is formulated as rods (larger pellets) of approximately 18 g of 0.0216 g of novaluron and labeled for application to larger water bodies; for a water body of 500 gallons, it can be inferred that 20 rods (363g) containing 0.44 g of novaluron are recommended. Based on these labeled application rates, novaluron concentrations in treated water bodies will reach saturation (3 ppm) and stay saturated until the pellets or rods have completely disintegrated. The proposed 90 day maximum applications rate for MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD are presented in **Table 5**. Although the proposed MOSQUIRON™ 0.12 CRD labeled use volumes are lower than for MOSQUIRON™ 0.12 P, MOSQUIRON™ 0.12 CRD control rods are intended for larger water bodies; neither label proposes a maximum water volume for the treated water body.

Table 5. Application Rates for MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD at the Maximum Application Rates per Water Volume

Water Volume (Liters)	Maximum Number of Pellets Applied	Maximum Application Rate (Grams)
MOSQUIRON™ 0.12 P		
2.0	2	0.4
7.6	8	1.6
76	76	15.2
379	380	76
1891	758	152
MOSQUIRON™ 0.12 CRD		

189.5	2	36.3
379	4	72.6
569	6	108.9
758	8	145.2

3.2 Environmental Fate and Transport Characterization

Novaluron laboratory and field studies indicate runoff of entrained sediments is most likely dissipation pathway for off-site movement of novaluron. Novaluron degradation in soil and water is controlled by microbial-mediated processes. Novaluron degrades to form chlorophenyl urea and 2,6-difluorobenzoic acid. Hydrolysis of degradation products leads to the formation of chloroaniline from chlorophenyl urea and 2,6 difluorobenzamide from 2,6-difluorobenzoic acid.

Novaluron is a chiral compound containing a racemic mixture of two enantiomers (R,S). The available environmental fate and ecological effects data on novaluron represents only the racemic mixture. Additional data on individual enantiomers may be required if the registrant chooses to develop isomeric enriched products of novaluron. Based on submitted environmental fate data and reported physical-chemical properties novaluron is not mobile and should not persist in most environments (**Table 6).**

Table 6. Environmental Fate and Transport Properties of Novaluron

Parameter	Value	Reference
PC Code	124002	
CAS Number	1167-46-6	Toxnet
Chemical (CAS) Name	[[[3-Chloro-4-[I, 1,2-trifluoro-2-(trifluoromethoxy)ethoxy]phenyl] -amino]carbonyl]-2,6-difluorobenzamide	
IUPAC Name	RS)-1-[3-Chloro-4 (1,1,2-trifluoromethoxyethoxy)phenyl]-3-(2,6-difluorobenzoy1)urea	
Molecular Formula	$C_{17}H_9C1FsN_20_4$	Toxnet
Molecular Weight	492.7	Toxnet
Water Solubility (pH 6, 20°C)	3 µg/L at 20° C	MRID 45638203
Henry's law constant (K_H)	2.0	Calculated from vapor pressure and water solubility.
Melting Point	177.5	Toxnet
Octanol-Water Partition Coefficient (log K_{ow}, 25°C)	4.3	MRID 45638405
Vapor pressure (20/25°C)	1.2 x 10^{-7} mm Hg	Toxnet
Hydrolysis at 25 "C	Stable at pH 5 and 7 $T_{1/2}$ = 101 days (at pH 9)	MRID 44961008
Photolysis in Water	$T_{1/2}$ = 187 days	MRID 45638203
Photodegradation on Soil	$T_{1/2}$ = 257 days	MRID 45638204
Aerobic aquatic metabolism	$T_{1/2}$ = 9.7-19.7 days	MRID 45638206
Aerobic soil metabolism	$T_{1/2}$ = 7- 31.9 days	MRID 44961009 MRID 44961010

Table 6. Environmental Fate and Transport Properties of Novaluron		
Parameter	**Value**	**Reference**
Anaerobic soil metabolism	$T_{1/2}$ = 49- 51 days	MRID 45638205 MRID 45789203
Terrestrial field dissipation	$T_{1/2}$ = 20 - 178 days (US, Canada, Spain, and Germany)	MRID 45638403
Bioaccumulation in fish	BCF = 14,431	MRID 45638215

3.2.1 Degradation

Novaluron is not persistent in soil laboratory studies; however, it appears to be more persistent in some field studies under actual use conditions. Novaluron persistence in field soils may be partially explained by temperature effects on metabolism; greater persistence is found in cooler climates.

Laboratory studies suggest that novaluron's major route of disappearance is microbially-mediated degradation. Novaluron degradation rates in aerobic soil appear to be dependent on temperature. At 20º C, novaluron metabolizes with half-lives ranging from 7 to 14.5 days to form chlorophenyl urea (275-352I) and chloroaniline (275-309I)(MRIDs: 44961009 and 44961010). At 10º C, novaluron degrades slower ($t_{1/2}$= 31.9 days) (MRID 44961009). In aquatic environments under stratified redox conditions (aerobic conditions in water and anaerobic conditions in soil) the chemical metabolizes with total system half-lives of 9.7 and 19.7 days (MRID 45638206). Under anaerobic conditions in water-soil systems, novaluron degrades slower with total system half-lives of 49 and 51 days (MRIDs: 45638205 and 45789203). A proposed transformation pathway in aquatic environments indicates novaluron forms 1-[3-chloro-4-(1,1,2-trifluoro-2-trifluoromethoxyethoxy)phenyl urea (275-352I) and 2,6-difluorobenzoic acid (275-158I, DFBA) through amide hydrolysis. Further hydrolysis of 275-352I yields 3-chloro-4-(1,1,2-trifluoro-2-trifluoromethoxyethoxy)aniline (275-309I) and hydrolysis of 275-158I yields 2,6-difluorobenzamide (275-157I) (MRID 5638206).

Novaluron was stable to hydrolysis at pH 5, 7, and 9 (pH 9 $t_{1/2}$ = 101 days (25º C) MRID 44961008) and stable to both soil photodegradation ($t_{1/2}$ = 257 days, MRID 45638204) and aqueous photolysis ($t_{/2}$ = 187 days, MRID 45638203). At 50º C in pH 9 buffer solution, however, novaluron appears to hydrolyze rapidly with a half-life of 1.2 days.

3.2.2 Dissipation

Novaluron tends to strongly adsorb to soil and sediment, and it is stable to abiotic processes. Novaluron has a very low potential to reach ground water. During surface runoff conditions, novaluron may reach water bodies as bound to soil particles and will likely partition into sediments once in surface water.

Novaluron tends to adsorb strongly to soil and sediment. The mean K_d values ranged from 95 to 247 ml/g, and K_{oc} values from 6,650 to 11,813 (MRID 44961012). There was no linear relationship between the soil organic carbon content and the K_d values for different soils. Thus, the K_{oc} model may not be appropriate. Because novaluron was

tested only at one concentration, Freundlich adsorption/desorption coefficients could not be calculated.

The high sorptive properties of novaluron indicate a low potential for leaching to ground water. In the field dissipation study conducted in North America, sites located in CA, LA, NY, WA, Nova Scotia, and Ontario, novaluron residues were not detected above 0.0851 ppm (Nova Scotia) in the 15-30 cm soil depth and above 0.0606 ppm (Ontario) in the 30-45 cm soil depths (MRID 45789204). In all sites, total water inputs (rainfall plus irrigation) were greater than the 10-year average rainfall except for the Nova Scotia site. Novaluron (RIMON® SUPRA 10EC) was not detected above the LOQ (10 ppb) at any sampling interval or in any replicate sample in the 10-20 cm soil depth when applied to bare soil in Spain and Germany (MRID 45638403). In these foreign studies pan evaporation data were not reported to assess whether sufficient moisture was present in the soil to facilitate leaching of the test substance. Irrigation was not applied to any of the test plots during the study trials and monthly rainfall data indicated that in the first 3 to 7 months rainfall was below historical average.

In a microcosm study, novaluron exhibited water column DT_{9O} values ranging from 12 to 20 days for three different test concentrations (*i.e.*, 5, 15, and 50 g a.i./ha treatment level; MRID 45785801). Only low concentrations of novaluron were detected in sediment, demonstrating potential for microbial degradation. This was confirmed by the presence of the main degradate, chlorophenyl urea (275-352I), in the water column of three out of five tested concentration and in soil of the highest tested concentration. Chlorophenyl urea (275-352I) was the only degradate analyzed in water and sediment.

3.2.3 Bioaccumulation

Novaluron appears to accumulate in edible and non-edible fish tissues. In a standard bioconcentration study using the bluegill sunfish, the highest mean bioconcentration factor (BCF) in whole fish was 14,431 x. The half-life for clearance of residues in the bluegill was 3.9 to 7.3 days for whole fish (MRID 45638215), suggesting that, while initial bioconcentration is high, changes in fish tissue would closely follow the dissipation pattern of novaluron in water.

3.2.4 Degradates of Concern

The Health Effects Division identified novaluron metabolites chlorophenyl urea and chloroaniline as residues of concern for drinking water (MARC, 2004). HED believes chlorophenyl urea shares similar toxicity as the parent because chlorophenyl urea can further degrade to chloroaniline, which is known to cause similar toxicological effects as the parent.

3.2.4.1 Chlorophenyl urea

The major novaluron degradate, chlorophenyl urea (275-352I), was formed in aerobic soil metabolism at a maximum rate of 26.6% of the applied parent at 7 days posttreatment

(MRID 44961009). Its aerobic soil metabolism half-lives estimated from the formation and decline curves (MRID 44961009) are 46.5 and 45.9 days. Based on the McCall et al., 1980 classification system the degradate appears to have low to slight mobility in soil (K_{oc} values range from 1950 to 2563 L/kg; MRID 45638201). The Freundlich isotherm, however, may not adequately represent adsorption of the compound across all concentrations (the 1/n values were not within the range of 0.9 to 1.1). Based on a laboratory study, novaluron degradates appear to have a very low potential for leaching into ground water. Chlorophenyl urea (275-352I) has the potential to reach surface water through runoff.

3.3 Monitoring Data

There were no available monitoring data at the time of this assessment (March, 2011).

3.4 Aquatic Concentration Estimates

3.4.1 PRZM/EXAMS Modeling for the Rimon Supra 10 EC Label for Outdoor Perimeter and Spot Treatment Uses

Estimated Environmental Concentrations (EECs) for aquatic ecosystems assessments for Rimon Supra 10 EC were estimated based on EFED's Tier II aquatic models: PRZM (Pesticide Root Zone Model) and EXAMS (EXposure Analysis Modeling System). **PRZM** is used to simulate pesticide transport as a result of runoff and erosion from a 10-ha agricultural field and **EXAMS** considers the environmental fate and transport of pesticides and predicts EECs in an adjacent small water body (10,000-m^2 pond, 2 m deep with no outlet), with the assumption that the small field is cropped at 100%. The model is designed to estimate pesticide concentrations found in water at the edge of the treated field. As such, it provides high-end values of the pesticide concentrations that might be found in ecologically sensitive environments following pesticide application. The linked PRZM-EXAMS modeling system considers multi-year simulations addressing runoff and spray drift from multiple applications.

The location of the application is simulated using site-specific information on the soils, weather and management factors associated with the scenario. These scenarios are intended to represent a high-end exposure site. Based on historical rainfall patterns, the multiple runoff events to the small water body were simulated during a 30 year period. Calculations are carried out with the linkage program shell - PE5V01.pl - which incorporates the standard scenarios developed by EFED. Additional information on these models can be found at: http://www.epa.gov/oppefed1/models/water/index.htm.

The input parameters used in this assessment were selected from the environmental fate data submitted by the registrant and in accordance with US EPA-OPP EFED water model parameter selection guidelines, *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides,* Version 2.1, 2009.

The scenarios were developed by EFED to represent nationwide high-end vulnerable

sites to run-off and erosion; and therefore, pesticide transport. The region specificity of the scenarios may require that several regional scenarios be run for pesticide use depending on the need to capture the most conservative set of results based on the differences in precipitation and soil characteristics**.** The CA Residential RLF, CA Turf RLF, FL Turf Std., and PA Turf Std scenarios were modeled for the proposed RIMON® SUPRA 10EC outdoor perimeter and spot treatment use.

EECs in surface water were calculated for **RIMON® SUPRA** outdoor perimeter and spot treatments using the Tier II PRZM and EXAMS models. PRZM/EXAMS is based on a standard scenario in which a ten-hectare watershed is completely treated and drains into a one-hectare pond. In order to estimate conservative EECs for outdoor perimeter and spot treatments it is assumed that a 10 hectare development such as a retirement community or town home association, in which pesticide spraying is conducted under the auspices of a single landscape maintenance program, is applied throughout the 10 hectartes on a single day.

EFED calculated a maximum application rate of 0.91 a.i. lbs/A (1.02 kg/ha) from the proposed RIMON® SUPRA 10EC product label for outdoor perimeter and spot treatments; however, Rimon is unlikely to be applied over an entire 10 ha watershed. Therefore, EFED modeled the outdoor perimeter and spot treatment use of novaluron at 0.1, 1.0, 10, 25, and 100% of a 10 ha watershed to estimate environmental exposure at various scales.

The RIMON® SUPRA 10EC label does not restrict the number of annual applications. For this assessment, the single application rate, at different scales, were modeled.

The PRZM/EXAMS model was employed to estimate novaluron concentrations in the water column. Water column EECs from spray applications of novaluron are used for comparison with toxicity endpoints for fish, invertebrates, and aquatic plants that live in the water column. Novaluron input parameters used in PRZM/EXAMS are listed in **Table 7** and an example **PRZM/EXAMS** output file is presented in **Appendix E**.

Table 7. PRZM/EXAMS Input Parameters for Novaluron for Outdoor Perimeter and Spot Treatment Uses

Parameter	Input Value and Unit	Source
Application Rate[1]	1.02 kg/ha – 100% of a watershed treated 0.255 kg/ha – 25% of a watershed treated 0.102kg/ha – 10% of a watershed treated 0.05kg/ha – 5% of a watershed treated 0.010kg/ha – 1% of a watershed treated	The maximum application rate of 1.02 kg/ha per ha calculated from product label. The other application rates are to 0.1, 1.0, 10 and 25% of a hectare.
Number of Applications	1 application	Product Label
First Application Date (day-month)	CA Res RLF 01-06 CA Tur RLF 01-06 FL Tuf Std 05-15 PA Turf Std 06-15	Cricket populations peak in late spring in North America
Molecular Weight	492.7 g/mole	Registrant Data

Table 7. PRZM/EXAMS Input Parameters for Novaluron for Outdoor Perimeter and Spot Treatment Uses		
Water Solubility @ 20° C	0.003 mg/L	Registrant Data
Vapor Pressure	1.2 x 10^{-7} torr	Registrant Data
Soil Partition Co-efficient K_d[2]	165 ml/g	MRID 44961012
Hydrolysis	$t_{½}$ = 0 days	MRID 44961008
Aqueous Photolysis[3]	Stable	MRID 45638203
Aerobic Soil Metabolism[4]	$t_{½}$ = 15.6 days	MRIDs 44961009 and 44961010
Aerobic Aquatic Metabolism Half-life[5]	$t_{½}$ = 21.9 days	MRID 45638206
Anaerobic Aquatic Metabolism Half-life	$t_{½}$ = 56.9 days	MRIDs 45638205 and 45789203
Application Fraction (percent applied)[5]	Ground – 1.0	Guidance for Selecting Input parameters in Modeling the Environmental Fate and Transport of pesticides (2009)
Spray Drift Fraction[6]	Ground – 1.0	Guidance for Selecting Input parameters in Modeling the Environmental Fate and Transport of pesticides (2009)

[1] Calculation for maximum application of diluted RIMON® SUPRA 10EC for outdoor perimeter and spot treatments:
(0.0201 lbs. a.i.

[2] An average soil adsorption constant, K_d, out of four soil adsorption K_d values (133, 247, 184, and 95) was used.

[3] The aqueous photolysis half-life is assumed stable for modeling purposes. The half-life of photodegradation in water half-life was estimated from extremely variable data within and between labeled study concentration data (r2 ranged from 0.0039 to 0.65). Because novaluron has a very long photodegradation half-life, it is not expected to impact the confidence in estimating environmental concentrations.

[4] Upper confidence bound on the mean of the aerobic soil metabolism half-life was used.

[5] Since n=2 (aerobic $t_{1/2}$**:** 15.7 and 9.7 days; anaerobic $t_{1/2}$: 50.6 and 53.7 days), the upper confidence bound on the mean aquatic metabolism half-life was used.

[6] Novaluron is applied as a spot treatment, 100 per cent application efficiency is assumed.

The modeled results for all scenarios are presented in **Table 8**. Peak EEC values were used to determine acute risks. The 21-day average EEC values were used to determine chronic risks to aquatic invertebrates. The 60-day average EEC values were used to determine chronic risks to aquatic fish. An example PRZM/EXAMS output file from the PE5 for ecological exposure assessment is presented in **Appendix E.**

Table 8. PRZM/EXAMS- Estimated Concentrations of Novaluron in Surface Water from Outdoor Perimeter Treatments and Spot Treatments			
Scenario	**Peak µg/L**	**21-day Average µg/L**	**60-Day Average µg/L**
100 % of 10 haWatershed Treated			
CA Res	0.13	0.09	0.06
CA Turf RLF	0.01	0.006	0.004
FL Turf	0.57	0.21	0.12
PA Turf	**0.96***	**0.36***	**0.16***
25 % of 10 haWatershed Treated			
CA Res RLF	0.03	0.02	0.02
CA Turf RLF	0.003	0.002	0.001
FL Turf	0.14	0.05	0.03
PA Turf	**0.24***	**0.09***	**0.04***
10 % of 10 haWatershed Treated			
CA Res	0.01	0.009	0.006
CA Turf RLF	0.001	0.0007	0.0004
FL Turf	0.06	0.02	0.01
PA Turf	**0.09***	**0.03***	**0.01***
5 % of 10 haWatershed Treated			
CA Res	0.006	0.004	0.002
CA Turf RLF	0.0006	0.0003	0.0002
FL Turf	0.03	0.01	0.006
PA Turf	**0.05***	**0.02***	**0.008***
1 % of 10 haWatershed Treated			
CA Res	0.001	0.001	0.001
CA Turf RLF	0.0001	6.55e-005	4.08e-005
FL Turf	0.006	0.002	0.001
PA Turf	**0.009***	**0.003***	**0.002***

*An asterisk indicates the concentration used for risk estimation

In **Table 9,** PRZM/EXAMS benthic pore water EECs are presented for the scenarios that produced the highest and lowest pore water EECs. All other modeled scenarios produced benthic pore water EECs within the range bounded by a ground applications to PA Turf and CA Turf.

Table 9. PRZM/EXAMS- Estimated Pore Water Concentrations of Novaluron in Surface Water from Outdoor Perimeter Treatments and Spot Treatments			
Scenario	**Peak µg/L**	**21-day Average µg/L**	**60-Day Average µg/L**
100 % of 10 haWatershed Treated			
CA Res	0.03	0.03	0.03
CA Turf RLF	0.002	0.002	0.002
FL Turf [1]	0.14	0.13	0.09
PA Turf	**0.13***	**0.13***	**0.11***
25 % of 10 haWatershed Treated			
CA Res	0.007	0.006	0.006
CA Turf RLF	0.0004	0.0004	0.0004
FL Turf [1]	0.01	0.01	0.01
PA Turf	**0.03***	**0.03***	**0.03***

Table 9. PRZM/EXAMS- Estimated Pore Water Concentrations of Novaluron in Surface Water from Outdoor Perimeter Treatments and Spot Treatments			
Scenario	**Peak µg/L**	**21-day Average µg/L**	**60-Day Average µg/L**
10 % of 10 haWatershed Treated			
CA Res	0.003	0.003	0.003
CA Turf RLF	0.0002	0.0002	0.0002
FL Turf [1]	0.006	0.006	0.004
PA Turf	**0.01***	**0.01***	**0.01***
5 % of 10 haWatershed Treated			
CA Res	0.001	0.001	0.001
CA Turf RLF	0.0001	0.0001	0.0001
FL Turf [1]	0.003	0.003	0.002
PA Turf	**0.007***	**0.006***	**0.005***
1% of 10 haWatershed Treated			
CA Res	0.0003	0.0003	0.0003
CA Turf RLF	0.00002	0.00002	0.00002
FL Turf [1]	0.0006	0.0006	0.0005
PA Turf	**0.001***	**0.001***	**0.001***

[1] Two applications made to FL Turf scenario

*An asterisk indicates the concentration is used for risk estimation

3.4.2 Estimated Environmental Concentrations for MOSQUIRON™ 0.12 P MOSQUIRON™ 0.12 CRD

MOSQUIRON™ 0.12 P and MOSQUIRON™ 0.12 CRD are applied directly to small water bodies, or dry areas prior to flooding; therefore, the EECs for these uses were calculated by dividing the mass of the active ingredient applied by the volume of water in the water body. The EECs for the proposed mosquito larvae use will be compared to fish, aquatic invertebrates, and aquatic plants. At the highest application rates, the calculated surface water environmental concentrations for MOSQUIRON™ 0.12 P MOSQUIRON™ 0.12 CRD exceed the limit of solubility; therefore, the limit of solubility of 3 µg/L is used as the peak, 21-day and 60 day EECs. The pore water EECs are assumed to be at the limit of solubility.

3.5 Terrestrial Exposure

The exposure routes of novaluron to terrestrial organisms are direct contact, residues on dietary items, pellet/rod consumption, and drinking water. For terrestrial wildlife, residue exposures on dietary items are modeled for outdoor control of crickets and exposures via pellet/rod consumption are modeled for outdoor control of mosquitoes. The concentrations of novaluron in contained bodies of water are also screened to determine if drinking water exposure to wildlife is a potential route of concern. Exposures to terrestrial plants via direct contact from spray applications are not presented due to lack of available terrestrial plant toxicity data; exposure to terrestrial plants via contact with pellet and rod formulations is expected to be minimal because a habitat supporting water bodies would likely exclude terrestrial plants. EFED does not have a preferred method of calculating exposures to terrestrial invertebrates; exposures to this taxon will be discussed

in the Risk Characterization.

T-REX v_1.4.1 (Oct. 9, 2008) was used to estimate potential acute and chronic dietary exposures to birds and mammals from the proposed outdoor control of. Residues on vegetative matter and terrestrial invertebrate prey items from spray applications were calculated based on a single application rate of 0.91 lbs a.i./A, assuming a default 35-day half-life (based on the work of Willis and McDowell (1987)) in lieu of available data. Results for birds and mammals are presented in **Tables 10** and **11**, respectively. An example T-REX output is provided in **Appendix F.**

Data are not generally available for screening level assessments to assess the terrestrial exposure and effects of degradates, as is the case for this assessment of novaluron. Based on the fate and toxicity data of chlorophenyl urea, the default 35-day foliar dissipation half-life used in the terrestrial modeling may not account for the formation and toxicity of chlorophenyl urea to terrestrial wildlife.

Table 10. T-REX v.1.4.1 Avian Exposure Concentration Estimates (EECs) for the Proposed Outdoor Control of Crickets at a Single Application of 0.91 lbs a.i./A

Feeding Category (application rate)	Dietary-Based EECs (mg/kg-Food item)	Dose-Based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
	Herbivores/Insectivores[1]			
Short grass	218	248	142	63.5
Tall grass	100	114	65.0	29.1
Broadleaf plants/small insects	123	140	80.0	35.7
Fruits/pods/seeds/large insects	13.7	15.6	8.86	3.97
	Granivores[2]			
Seeds Only	13.7	3.45	1.97	0.88

[1] Percent body weight consumed for a 20, 100, and 1000 gram herbivore/insectivore bird equals 114%, 65%, and 29%, respectively.
[2] Percent body weight consumed for a 20, 100, and 1000 gram granivore bird equals 25%, 14%, and 6%, respectively.

Table 11. T-REX v.1.4.1 Mammalian Exposure Concentration Estimates (EECs) for the Proposed Outdoor Control of Crickets at a Single Application of 0.91 lbs a.i./A

Feeding Category (application rate)	Dietary-Based EECs (mg/kg-Food item)	Dose-Based EECs (mg/kg-bw)		
		Small (15 g)	Medium (35 g)	Large (1000 g)
	Herbivores/Insectivores[1]			
Short grass	218	208	144	33.4
Tall grass	100	94.4	66.0	15.3
Broadleaf plants/small insects	123	117	81.0	18.8
Fruits/pods/seeds/large insects	13.7	13.0	8.99	2.09
	Granivores[2]			
Seeds Only	13.7	2.89	2.00	0.46

[1] Percent body weight consumed for a 15, 35, and 1000 gram herbivore/insectivore mammalian equals 95%, 66%, and 15%, respectively.
[2] Percent body weight consumed for a 15, 35, and 1000 gram granivore mammal equals 21%, 15%, and 3%, respectively.

Direct consumption of the solid pellets/rods by terrestrial organims is a potential exposure route of concern. **Table 12** provides information on the pellet/rod formulations of novaluron. The **Table** also presents the number of pellets/rods that may be applied to a natural or manmade depression up to a fill concentration of 500 gallons (although a fill concentration of >500 gallons is possible). Exposure to wildlife via pellet/rod consumption is possible because applications can be made to areas prior to flooding (dry areas); additionally, birds may pick out the pellets/rods applied to shallow water bodies.

Table 12. Exposure Concentration Estimates (EECs) to Terrestrial Organisms for the Proposed Outdoor Pellet/rod Control of Mosquito Larvae

Formulation	% Active Ingredient in Product	Weight of Pellet/rod[1]	mg a.i./pellet/rod	Number of pellets applied (based on volume of water)
MOSQUIRON™ 0.12P	0.12	1 pellet = 0.2 g	0.24	758 pellets for 500 gallons (182 mg novaluron)
MOSQUIRON™ 0.12CRD	0.12	1 rod = 18 g	21.6	20 rods for 500 gallons (432 mg novaluron)

[1] Formulated as pellets and rods; weight provided on label

SIP_v.1.0 (June 15, 2010) provides an upper bound estimate of exposure to birds and mammals through drinking water alone. **Table 13** presents the acute and chronic upper bound estimates of exposure to a 1000g mammal and 20g bird. SIP is a screening-level model intended to determine whether or not drinking water exposure alone is a potential pathway of concern; risk quotients are not generated. SIP employs the conservative assumption that the pesticide concentration in drinking water is at the solubility limit. Based on labeled use information, novaluron saturation (at 3 ppb) will occur in treated water bodies.

Table 13. SIP v.1.0 Upper Bound Exposure Concentration Estimates (Dose) for Drinking Water at Novaluron's Solubility Limit of 3 ppb for Proposed Outdoor Control of Mosquito Larvae

Taxa	Acute Dose (mg a.i./kg bw)	Chronic Dose (mg a.i./kg bw)
Mammal – 1000g	0.0005	0.0005
Bird – 20g	0.0024	0.0024

4. ECOLOGICAL EFFECTS SUMMARY

A summary of aquatic and terrestrial organism toxicity data use for risk estimation are presented below. Toxicity data for novaluron are available for the technical grade active ingredient (TGAI), formulated products, and the degradate chlorophenyl urea. **Tables 14 and 15** summarize the most sensitive aquatic organism toxicity endpoints for novaluron. Aquatic toxicity data for chlorophenyl urea is not evaluated in this risk assessment and is not presented below. **Tables 16, 17, and 18** present the most sensitive terrestrial organism toxicity endpoints available for novaluron and the degradate, chlorophenyl urea. A complete listing of all submitted novaluron toxicity data by MRID number is

located in **Appendix A**. Details on the toxicity studies can be accessed from previous ecological risk assessments for Novaluron[3].

Table 14. Summary of Aquatic Animal Toxicity Data Used in Risk Estimation for Novaluron

Species	Acute Toxicity		Chronic Toxicity	
	LC_{50} / EC_{50}	**MRID**	**NOAEC / LOAEC, Most Sensitive Endpoint(s)**	**MRID**
Freshwater Fish Rainbow trout (*Salmo gairdneri*)	96-hr LC_{50} > 980 µg a.i./L No mortality or sublethal effects	45499004	NOAEC = 6.16 µg a.i./L LOAEC > 6.16 µg a.i./L none	45638216
Freshwater Pelagic Invertebrate Water flea (*Daphnia magna*)	Estimated EC_{50} = 0.15 µg a.i./L[1]	--	NOAEC = 0.03 µg a.i./L LOAEC = 0.06 µg a.i./L Parental survival and offspring production	45638211
Freshwater Benthic Invertebrate Chironomid (*Chironomus riparius*)	--	--	**NOAEC** 15 ug a.i./kg sediment 0.04 ug a.i./L overlying water 0.13 ug a.i./L pore water **LOAEC** 30 ug a.i./kg sediment 0.08 ug a.i./L overlying water 0.26 ug a.i./L pore water	47621902
Estuarine/Marine Fish Sheepshead minnow (*Cyprinodon variegates*)	96-hr LC_{50} > 2 µg a.i./L No mortality or sublethal effects occurred	45638210	--	--
Estuarine/Marine Invertebrate Mysid Shrimp (*Americamysis bahia*)	96-hr LC_{50} = 0.13 µg a.i./L Sublethal effects noted	45638209	NOAEC = 0.03 µg a.i./L LOAEC = 0.06 µg a.i./L Reduction in terminal male body length	45638212

[1]Calculated based on Acute to Chronic Ratio approach [An estimated acute LC_{50} of 0.15 ppb was derived for freshwater invertebrates using the equation: $Acute\ toxicity_{fw} = Chronic\ toxicity_{fw} \times Acute\ toxicity_{est\text{-}mar} / Chronic\ toxicity_{est\text{-}mar}$ (0.0299 x 0.13 / 0.026 = 0.15)

None of the acute fish (freshwater or estuarine/marine) studies (MRID 45499005 and 45638216) established definitive endpoints for novaluron (LC_{50} values were greater than the highest concentrations tested). However, no acute effects are expected for fish in either media as the reported NOAEC values for sublethal effects in these acute studies were close to or greater than the solubility limit for novaluron (3 ppb). The lowest no-effect level derived for fish from chronic toxicity studies was based on observed effects on mortality and terminal growth (MRID 45638216); this NOAEC for freshwater fish is also close to the solubility limit for novaluron.

Novaluron is classified highly toxic to both freshwater and estuarine/marine invertebrates on an acute exposure basis. The chronic aquatic invertebrate endpoints were based on parental survival and offspring production (in water flea) and a reduction in terminal

[3] These assessments are associated with the following DP Barcodes: 318619, 285499, 285479, 287624, 297230, 321545, 358376, 364309, 364313, and 378620.

male body length (in mysid shrimp). A prolonged sediment toxicity test with *Chironomus riparius* demonstrates the impact of novaluron on benthic organisms (MRID 47621902; OECD 218). This study observed significant ($p<0.05$) reductions in survival at 30 ug a.i./kg sediment compared to controls. Percent mortality at 30 ug a.i./kg was 73% compared to 16% mortality in controls. The NOAEC in this study was 15 ug a.i./kg sediment (0.13 ug a.i./L pore water).

A community of selected algae and aquatic invertebrates was evaluated in a microcosm study for novaluron (MRID 45885801). The principle objectives of the study were to assess the potential biological effects of novaluron in invertebrate communities and define the no effect concentration (NOAEC) and ecologically acceptable concentration (EAC). No fish were included in the community structure. Analyses of benthic invertebrate populations were conducted primarily at the family level, with subsequent analysis to more refined taxonomic levels for those organisms showing definitive responses to novaluron treatment. Analysis of benthic invertebrate community response (taxonomic response weighting) shows statistically significant ($p<0.05$) community level effects at the 0.15 ug a.i./L concentration level, with a community level response NOAEC of 0.05 ug a.i./L (also the EAC). It should be noted that the Gammaridea showed statistically adverse response ($p<0.01$) below that observed for the community as whole, with an NOAEC <0.05 ug a.i./L and complete eradication of the family at all dose groups by study termination.

Table 15. Summary of Aquatic Plant Toxicity Data Used in Risk Estimation for Novaluron

Species	LC_{50} or EC_{50}/NOAEC (µg ai/L)	MRID
Non-Vascular Plant Green algae (*Selenastrum capricornutum)*	EC_{50} = 3549 µg a.i./L NOAEC = 2475 µg a.i./L	45638411[1]
Vascular Plant Duckweed (*Lemna minor*)	EC_{50} >75.4 µg a.i./L NOAEC = 75.4 µg a.i./L	45638223[1]

[1] Toxicity study conducted with the formulated product RIMON® SUPRA 10EC .

The risk assessment for aquatic plants is based on the vascular duckweed (MRID 45638223), with an EC_{50} > 75.4 µg a.i./L and NOAEC = 75.4 µg a.i./L, and the nonvascular green algae (45638411), with an EC_{50} = 3549 µg a.i./L and NOAEC = 2,475 µg a.i./L (**Table 15).**

Table 16. Summary of Terrestrial Toxicity Data Used in Risk Estimation for Novaluron				
Species	**Acute Toxicity**		**Chronic Toxicity**	
	LD_{50} / LC_{50}	**MRID**	**NOAEC(L)/ LOAEC(L)**	**Affected Endpoints (MRID)**
Northern Bobwhite Quail (*Colinus virginianus*)	14-day LD_{50} > 2000 mg a.i./kg bw NOAEC = 2000 mg a.i./kg bw	45476801	--	--
	8-day LC_{50} > 5200 mg/kg diet NOAEC = 2610 mg a.i./kg diet	45499002		
Mallard Duck (*Anas platyrhynchos*)	--	--	22-wk NOAEC = 9.8 mg a.i./kg diet 22-wk LOAEC = 30 mg a.i./kg diet	Number of viable embryos per pen and viable 14-day embryos set (45638219)
Laboratory rat	14-day LD_{50} >5000 mg ai/kg-bw	44961001	NOAEC = 1000 mg ai/kg-diet LOAEC = 4000 mg ai/kg-diet	Decreased sperm counts in male F1 generation (45651505)

Novaluron is classified practically non-toxic to birds and mammals on an acute oral basis and non-toxic to birds on subacute dietary basis (**Table 16**). On a chronic exposure basis, significant reduction in the number of viable embryos per pen and viable embryos of eggs set were noted in Northern bobwhite quail. Decreased sperm counts in male F1 generation and increased absolute and relative spleen weights in the parental generation were noted in rats.

Table 17. Summary of Terrestrial Invertebrate Toxicity Data for Novaluron					
Study Type/ Species	**Product Tested (% ai)**	**Toxicity Endpoint**	**Toxicity Categories**	**Study Classification**	**MRID #**
Acute Contact/ Honey bee (*Apis melifera*)	Technical grade (99.3)	48-hr LD_{50} >100 µg a.i./bee NOAEC = 100 µg a.i./bee	Practically Non-Toxic	Acceptable	45638220
Acute Oral/ Honey bee (*Apis melifera*)		48-hr LD_{50} >100 µg a.i./bee NOAEC = 100 µg a.i./bee	n/a	Supplemental	
Acute Contact/ Honey bee (*Apis melifera*)	Formulated product (9.1)	48-hr LD_{50} >200 µg a.i./bee NOAEC = 200 µg a.i./bee	Practically Non-Toxic	Acceptable	45638408
Acute Oral/ Honey bee (*Apis melifera*)		48-hr LD_{50} >200 µg a.i./bee NOAEC = 200 µg a.i./bee	n/a	Supplemental	

Table 17. Summary of Terrestrial Invertebrate Toxicity Data for Novaluron					
Study Type/ Species	**Product Tested (% ai)**	**Toxicity Endpoint**	**Toxicity Categories**	**Study Classification**	**MRID #**
Acute Toxicity Earthworm (*Eisenia foetida*)	Technical grade (99.3)	14-day LC_{50} >1000 mg a.i./kg soil NOAEC >1000 mg a.i./kg soil	n/a	Supplemental	45638224

Novaluron is categorized practically non-toxic to honey bees on a contact basis for the TGAI (MRID 45638220) and formulated product, RIMON® SUPRA 10EC (MRID 45638408) (**Table 17**). While the Agency does not categorize toxicity for acute oral studies, no acute oral effects were observed in honey bees dosed up to 100 µg a.i./bee for the TGAI (MRID 45638220) and 200 µg a.i./bee for the formulated product, RIMON® SUPRA 10EC (MRID 45638408).

In addition to the contact and oral toxicity studies on honey bees, three field studies (MRIDs 45638407; 45638409; 45638410) are available which evaluated the formulated produect RIMON® SUPRA 10EC on non-target insects. Novaluron exposure to beehives via the formulated product was evaluated in two studies (MRID 45638407 and 45638409), in which adverse effects were observed on honeybee brood development at the egg, young larvae, and old larvae developmental stages. Wasp and predatory mite populations showed significant adverse effects to exposure of novaluron in a third field study (MRID 45638410).

The following open literature studies are available for novaluron. Hodgeson *et al*., 2011 was reviewed for inclusion in risk characterization of the proposed new novaluron uses because it provides information on the developmental toxicity of novaluron to non-*Apis* bees (Section 5.1.2).

- Sfara, V., S.A. De Licastro, H.M. Masuh, E.A., Seccacini, R.A. Alzogaray, and E.N. Zerba, 2007. Synergism between cis-permethrin and benzoyl phenyl urea insect growth regulators against *Aedes aegypti* larvae. J. Am. Mosq. Control Assoc. 23(1): 24-28. ECOTOX Reference No: 100192.
- Scott-Dupree, C.D., L. Conroy, and C.R. Harris, 2009. Impact of currently used or potentially useful insecticides for canola agroecosystems on *Bombus impatiens* (Hymenoptera: Apidae), *Megachile rotundata* (Mymenoptera: Megachilidae), and *Osmia lignaria* (Hymenoptera: Megachilidae). J. Econ. Entomol. 102(1): 177-182. ECOTOX Reference No. 113327.
- Mommaerts, V., G. Sterk, and G. Smagghe, 2006. Hazards and uptake of chitin synthesis inhibitors in bumblebees *Bombus terrestris*. Pest Manag. Sci. 62 (8): 752-758. ECOTOX Reference No: 94221.
- Hodgson EW, Pitts-Singer TL, Barbour JD. 2011. Effects of the insect growth regulator, novaluron on immature alfalfa leafcutting bees, *Megachile rotundata*. *Journal of Insect Science* 11:43. Available online: insectscience.org/11.43

The toxicity of both technical grade novaluron and its primary degradate chlorophenyl

urea to earthworms were evaluated in accordance with OECD guidelines (MRID 45638224 and 45638225, respectively). The reported LC_{50} for the technical grade product and chlorophenyl urea was >1000 and 447 mg/kg, respectively (**Tables 17** and **18**). No sub-lethal effects were observed in either study.

Table 18. Summary of Terrestrial Invertebrate Toxicity Data for Chlorophenyl Urea

Study Type	Product Tested (% ai)	Toxicity Endpoint (mg a.i./kg soil)	Toxicity Category	Study Classification	MRID #
Acute Toxicity Earthworm (*Eisenia foetida*)	Chlorophenyl urea (99.3)	14-day LC_{50} = 447 NOAEC = 171	n/a	Supplemental	45638224

Toxicity studies on terrestrial plants are not available for novaluron or its degradates.

5. ECOLOGICAL RISK CHARACTERIZATION

5.1 Risk Estimation

5.1.1 Aquatic Organisms

Fish

Risk quotients were not calculated for acute risks to freshwater or estuarine/marine fish because none of the acute fish studies established definitive endpoints for novaluron. However, no acute effects are expected for fish in either media as the reported NOAEC values for sublethal effects in these acute studies were close to or greater than the solubility limit for novaluron (3 ppb); acute risk to fish is not expected. Chronic RQs for freshwater fish are presented in **Table 19** for the proposed novaluron uses; RQs for both proposed uses are below the Agency's risk to non-listed and listed species LOC (1.0). No toxicity data are available to assess chronic risk of novaluron exposure to estuarine/marine fish; risk to estuarine/marine fish on a chronic basis is presumed. Although fish are not expected to be present in contained, small water bodies, fish are used as a surrogate for aquatic-phase herpetafauna.

Table 19. Chronic RQs* for Freshwater Fish Based on Surface Water EECs of Novaluron

For Control of	Surface Water EECs (µg a.i./L)		Chronic RQ[1]
	Peak	60-day	
Crickets 100% watershed treated[3] (0.91 lbs a.i./L)	0.96	0.16	0.03
Mosquito Larvae in contained, small water bodies	3.0[2]	3.0[2]	0.49

*****Chronic risk to listed and nonlisted fish LOC is 1.0

[1] Based on freshwater fish NOAEC = 6.16 µg a.i./L

[2] EEC based on the functional limit of solubility

[3] Assessment models a 10 hectare watershed

Aquatic Invertebrates

Novaluron is a member of a larger group of insecticides known as benzoylphenyl ureas. It is an insect growth regulator that interferes with chitin synthesis and deposition. This mode of action is effective in controlling immature insect growth stages. Because chitinase inhibitors act primarily in the molting stages, endpoints based on effects to adults or non-molting juveniles do not accurately reflect the toxicity of the compound. Effects on target (and non-target) organisms are most severe when exposure occurs at critical life stages.

Aquatic guideline tests, which typically run for 48 hours for the aquatic invertebrate (*Daphnia magna*), may not capture a molting stage and are not an appropriate "most sensitive" acute endpoint for assessments. Endpoints derived from chronic studies more appropriately assess the toxicity of this type of chemical. No observed adverse effects concentrations (NOAECs) from the chronic guideline tests have been used to evaluate both acute and chronic risk in this assessment.

Risk quotients for aquatic invertebrates are presented in **Table 20**. Toxicity data on *D. magna* and *A. bahia* are used to derive risk quotients for pelagic invertebrates in freshwater and estuarine/marine environments, respectively. The chronic endpoint values for both species were identical (NOAEC = 0.03 µg a.i./L), however the NOAEC was based on parental survival and offspring production for *D. magna* and reduction in terminal male body length for *A. bahia*. Toxicity data were available on the freshwater benthic chironomid, *C. riparius*; the chronic NOAEC = 0.13 µg a.i./L (pore water concentrations) was based on survival and emergence ratios. Risk quotients for the proposed mosquito larvae use exceeded the Agency's LOC for both pelagic and benthic organisms. For pelagic invertebrates exposed to the proposed cricket use, the Agency's LOC (1.0) was exceeded for applications to treated areas of 10-100% of a 10 ha watershed. Benthic freshwater RQs for the proposed cricket use exceeded the LOC for the scenario in which 100% a 10 ha watershed was treated.

Table 20. RQs[1] for Aquatic Invertebrates Based on Surface Water and Pore Water EECs of Novaluron

For Control of	Pelagic Freshwater and Estuarine/Marine Invertebrates		Benthic Freshwater Invertebrates	
	Surface Water 21-day EEC	Acute/Chronic RQ[1]	Pore Water 21-day EEC	Acute/Chronic RQ[1]
Crickets				
100% watershed treated[5] (0.91 lbs a.i./L)	0.36	**12.0***	0.13	**1***
25% watershed treated[5] (0.23 lbs a.i./L)	0.09	**3.0***	0.03	0.23
10% watershed treated[5] (0.09 lbs a.i./L)	0.03	**1.0***	0.01	<0.1
5% watershed treated[5] (0.05 lbs a.i./L)	0.02	0.67	<0.01	<0.1

1% watershed treated[5] (0.01 lbs a.i./L)	0.003	0.33	<0.01	<0.1
Mosquito Larvae in contained, small water bodies	3.0[4]	**100***	3.0[4]	**23***

*RQ exceeds the chronic risk to listed and nonlisted freshwater and estuarine/marine invertebrate LOC (1.0)

[1] RQs for aquatic invertebrates are based on chronic exposure and toxicity data and represent the risk estimation for both acute and chronic effects

[2] Based on freshwater and estuarine/marine invertebrate NOAECs = 0.03 µg a.i./L

[3] Based on freshwater invertebrate pore water NOEAC = 0.13 µg a.i./L

[4] EEC based on the functional limit of solubility

[5] Assessment models a 10 hectare watershed

Aquatic Plants

No aquatic plant RQ exceeded the Agency's listed or non-listed species LOC (1.0) for either of the proposed novaluron uses (**Table 21**). Risk to aquatic plants is expected to be negligible.

Table 21. RQs* for Aquatic Vascular and Nonvascular Plants Based on Surface Water EECs of Novaluron

For Control of	Peak EEC (µg a.i./L)	Vascular Plant RQs		Non-Vascular Plant RQs	
		Listed[1]	Non-Listed[2]	Listed[3]	Non-Listed[4]
Crickets 100% watershed treated[6] (0.91 lbs a.i./L)	0.96	<0.1	<0.1	<0.1	<0.1
Mosquito Larvae in contained, small water bodies	3.0[5]	<0.1	<0.1	<0.1	<0.1

***** Risk to listed and nonlisted aquatic plant LOC is 1.0

[1] Based on aquatic vascular plant NOAEC = 2475 µg a.i./L

[2] Based on aquatic vascular plant EC_{50} = 3549 µg a.i./L

[3] Based on aquatic nonvascular pant NOAEC = 75 µg a.i./L

[4] Based on aquatic nonvascular plant EC_{50} > 75 µg a.i./L

[5] EEC based on the functional limit of solubility of novaluron

[6] Assessment models a 10 hectare watershed

5.1.2 Terrestrial Organisms

Birds and Mammals

Novaluron was classified as practically non-toxic to birds on an acute oral and acute dietary basis and practically non-toxic to mammals on an acute oral basis. Risk quotients for acute exposures to birds and mammals were not calculated because the available acute endpoints are non-definitive (*i.e.* greater than values); the lethal dose at which 50% mortality occurred was greater than the Agency's limit doses. Therefore, acute risks to nonlisted birds and mammals are not expected.

Risk quotients were calculated for chronic exposures of novaluron on food items of birds and mammals from the proposed novaluron control of crickets (**Table 22**). The chronic avian 22-wk NOAEC=9.8 mg a.i./kg-diet is based on a reduction in the number of viable embryos per pen and viable 14-day embryos; the chronic mammalian NOAEC=1000 mg a.i./kg-diet (NOAEL=74.2 mg a.i./kg-bw) is based on decreased sperm counts in the male F1 generation. The Agency's LOC was exceeded for avian dietary RQs for all dietary items; mammalian dose-based RQs exceeded the Agency's LOC for 15g and 35g mammals consuming short grass.

Table 22. Chronic Avian and Mammalian RQs for the Proposed Novaluron Control of Crickets Derived from T-REX v.1.4.1

Dietary Item	Avian Dietary RQ	Mammalian Dietary RQ	Mammalian Dose-based RQ		
			15g	35g	1000g
Short Grass	**22.3***	0.22	**1.28***	**1.09***	0.58
Tall Grass	**10.2***	0.10	0.59	0.50	0.27
Broadleaf plants/small insects	**12.5***	0.12	0.72	0.61	0.33
Fruits/pods/seeds/large insects	**1.39***	<0.10	0.08	0.07	0.04
Seeds Only (Granivore)	**1.39***	<0.10	0.02	0.02	0.01

* RQ exceeds the listed and non-listed avian and mammalian LOC (1.0)

Bird and mammal exposure to pellet and rod formulations of novaluron for control of mosquito larvae, via direct consumption, is possible for the proposed pellets/rod formulations in dry and wet areas. However, because both mosquito larvae control products use wax as a vehicle for the slow release of novaluron, the attractiveness of the pellets and rods to mammals and birds is uncertain. Beklova and Pikula (2000), studied the attractiveness of rodenticide bait to pheasants (*Phasianus colchicus*) made of alfalfa, sugar, groats, paraffin wax, and other effective substances and dyes. The study authors concluded that the paraffin wax coating had a repellent effect on the birds, which might otherwise be attracted to the alfalfa, sugar and groats. The study authors noted a repellent effect immediately after presenting the birds with fresh bait, but the effect subsided with the disintegration of the wax; the birds then found the bait appealing enough to consume. Based on this study's findings, the proposed novaluron pellet and rod products are expected to be unattractive to birds and mammals (*i.e.*, pellets/rods are not identified as a food source), and consumption of the pellets/rods is expected to be negligible. Thus, adverse effects to birds and mammals from acute and chronic exposures to the proposed pellets/rods are discountable.

SIP_v.1.0 was used to determine if chronic drinking water exposure to birds and mammals from the control of mosquito larvae in small, contained water bodies (*e.g.* bird bath) was a pathway of concern; based on toxicity data, acute adverse effects to birds and mammals from drinking water exposure to novaluron are not expected. SIP_v.1.0 employs the following assumptions about the exposure to birds and mammals: (1) The assessed animals obtain 100% of their daily water needs through drinking water; (2) The daily water need is equivalent to the daily water flux rate as calculated by Nagy and Peterson (1988); (3) The body weight of the assessed bird is equivalent to the smallest

generic bird modeled in T-REX (*i.e.*, 20 g), and this assumption results in the highest ratio of exposure to toxicity for the 3 assessed avian body weights of T-REX (*i.e.*, 20, 100, 1000 g); (4) The body weight of the assessed mammal is equivalent to the largest generic mammal modeled in T-REX (*i.e.*, 1000 g), and this results in the highest ratio of exposure to toxicity for the 3 assessed mammalian body weights of T-REX (*i.e.*, 15, 35, 1000 g). Based on a ratio of exposure and toxicity (**Table 23**), it was determined that drinking water exposure from the proposed control of mosquito larvae in small, contained water bodies is not a potential concern for birds or mammals on a chronic basis.

Table 23. SIP_v.1.0 Results of Drinking Water Screen from Proposed Control of Mosquito Larvae

Parameter	Chronic Avian Concern	Chronic Mammalian Concern
Upper Bound Exposure	0.0024 mg a.i./kg-bw	0.0005 mg a.i./kg-bw
Adjusted Toxicity Value	0.4862 mg a.i./kg-bw	57.0717 mg a.i./kg-bw
Ratio of exposure to toxicity	0.0050	<0.0001

Terrestrial Invertebrates

Currently, EFED does not routinely quantify potential risks from pesticides on terrestrial non-target adult insects. However, based on the data already submitted on adult honey bee toxicity, novaluron is practically non-toxic to honey bees (LD_{50} = >100 µg/bee). Therefore, the potential risk of novaluron to adult pollinators and other adult beneficial insects is expected to be low.

Since novaluron acts through chitin biosynthesis inhibition of the developing insects, reliance on adult insect toxicity testing is inadequate to comprehensively address its effects on non-target insects. Additional non-guideline non-target insect studies that evaluated the effects of novaluron on the developmental stages of honey bee demonstrated adverse effects on brood development at all growth stages (MRIDs 45638407 and 45638409).

MRID 45638407 pertains to a study where honey bee hives, placed in a grass field, were fed with sucrose solution dispersed with novaluron at a single concentration of 3.3 ml/L. Significant adverse effects included reduction in successful development of eggs and old larvae 7 days after treatment and young larvae 2 days after treatment. Overall failure rate of eggs, young larvae, and old larvae in treated hives was more than two, three, and four times greater than that of the control treatment. Adverse effects persisted throughout the duration of the study (21 days). An LC_{50} (>3.3 ml/L) could not be determined for this study as mortality was not observed in any of the developmental stages (due to the overall failure rate).

MRID 45638409 refers to a study conducted in Israel where honey bee colony brood development was evaluated in commercial orange groves following two spray applications of novaluron at flowering at 0.2 lb ai/A (0.225 kg ai/ha) each at 7 day intervals. Significant adverse effects were noted on egg development, young larvae, and old larvae following the first application of novaluron; however, second generation eggs developed normally. Similar to the MRID 45638407, this study did not note any

mortality of adult bees (LC_{50}= >0.2 lb ai/A). Based on the post-study monitoring results, adverse effects on honey bee brood development were transient and no evidence of adverse effects was apparent on hive viability, pollination efficiency, or productivity of worker bees. It is important to note that the single application rate tested in this study (0.2 lb ai/A) does not represent the maximum commercial use rate for novaluron (0.32 lb ai/A in orchard fruits).

Adverse effects were also noted on wasp and predatory mite populations following two applications of novaluron 7 days apart at the end of flowering to citrus groves in Sicily (MRID 45638410). However, complete recovery of wasps and predatory mites occurred within two days and 2 months, respectively, after the second application. No other effects were observed in any of the other taxa in this study.

In summary, the registrant-submitted studies on brood development of non-target insects (honey bees) did not test the maximum commercial application rate for novaluron and is likely lower than the potential usage of novaluron for outdoor residential control of crickets.

An open literature study (Hodgeson *et al*., 2011) evaluated novaluron toxicity, as formulated in Rimon 0.83 EC (9.3% w/v), to *Megachile rotundata*, alfalfa leafcutting bees. The second of three experiments studied the effect that adult bees feeding/foraging on novaluron had on the subsequent success of mating and reproduction. The experiment evaluated one novaluron treatment, 10% sugar-water containing novaluron at 0.08 lbs a.i./A using 30 gallons water/acre (3 µl form/mL water) against a control of 10% sugar-water. This experiment was conducted 3 times in total, for three replicates; however, nesting in the second and third test was lower due to limited flower availability. In the first replication, complete mortality (100%) was observed in the developing larvae from the treatment cages compared to 12% and 20% in the control cages; in the second replication, 50% and 92% mortality of larvae occurred compared to 0% and 18% in the control. In the third replication, 100% percent mortality occurred in larvae from treatment cages compared to 0% mortality (complete survivorship) in the control. This open literature study demonstrates that novaluron is not toxic to adult *M. rotundata* adults (as expected) but is toxic to the developing larvae. The study provides insight into the developmental effects in non-*Apis* bees. For solitary bees, such as *M. rotundata*, which may have as few as 1-3 generations per year, greater than 50% mortality to developing pupae would have significant effects on the reproductive success of the species.

Based on the studies summarized above, adverse effects on non-target insects are expected for the proposed use.

Available toxicity data on earthworms indicate that chlorophenyl urea is at least slightly more toxic to earthworms than novaluron. No adverse effects on earthworms were observed in a 14-day toxicity study for novaluron, with a resulting NOAEC = 1000 mg a.i./kg soil. Mortality and reductions in body weight occurred in the chlorophenyl urea toxicity study with earthworms, resulting in an LD_{50} = 447 mg a.i./kg soil and NOAEC = 171 mg a.i./kg soil.

Terrestrial Plants

No available data exists on novaluron toxicity to terrestrial plants. It is noted that this product has been previously registered on ornamentals, pome fruit, cotton, potato, head and stem brassica, tomato, sugarcane, stone fruit, bushberry, brassica leafy greens, turnip greens, sorghum, fruiting and curcurbit vegetables, low growing berries, snap and dry bean, swiss chard, and sweet corn, and novaluron may not be lethal to many plants up to the previously registered application rates. However, effects on terrestrial plant growth (height and dry weight) and toxicity to listed species are unknown. Further, because the proposed spray applications are not limited on a spatial or temporal scale, adverse effects to terrestrial plants are presumed from the proposed RIMON® SUPRA 10EC applications.

5.2 Risk Description

Natural water bodies are at potential risk from some of the proposed novaluron uses to control mosquito larvae; however, risk to these natural water bodies cannot be assessed quantitatively. Instead, it can be concluded from a qualitative assessment of risk that risk to organisms in a natural water would be no greater than the risk posed by novaluron to organism located in the treated areas. Thus, the potential for adverse effects to a species (or species used as a surrogate) as determined in the sections below provide a maximum level of expected population or community level risk to novaluron concentrations in natural water bodies from mosquito larvae use. As opposed to the localized concern in the treated water body, the concern for natural water bodies exposed to novaluron is the potential for large scale aquatic ecosystem direct and indirect effects at multiple levels of the trophic system.

5.2.1 Risks to Aquatic Organisms

It was determined in the risk estimation that acute risks to fish are not expected for the proposed novaluron uses based on acute toxicity data. Chronic adverse effects on aquatic-phase herpetofauna, for which fish serve as a surrogate, from proposed novaluron use on mosquito larvae is not expected because concentrations of novaluron in small water bodies is likely limited by novaluron's low solubility (3 ppm); the calculated RQ (0.49) for mosquito larvae use was below the Agency's LOC (1.0). A chronic RQ (0.03) was calculated for the proposed cricket use assuming an entire 10 ha watershed was treated with novaluron and was also below the Agency's LOC. Although this scenario (assuming 100% of the watershed is treated) is believed to be a conservative estimate of exposure, chronic risk to freshwater fish will likely be limited by the low solubility limit of novaluron. However, novaluron's persistence in water (aerobic aquatic metabolism half-lives ranged 9.7-19.7 days) lends uncertainty to potential chronic risk to estuarine/marine fish, for which no data is available. Chronic risk to estuarine/marine fish is presumed from the proposed RIMON® 10EC use on crickets.

Chronic toxicity endpoints were used to derive risk quotients (acute/chronic) for aquatic

invertebrates (as discussed in the Risk Estimation Section). For pelagic freshwater and estuarine/marine invertebrates exposed to the proposed cricket use, the Agency's LOC (1.0) was exceeded for applications to treated areas of 10-100% of a 10 ha watershed. Benthic freshwater RQs for the proposed cricket use exceeded the LOC for the scenario in which 100% the waterdshed was treated. Only freshwater invertebrates are expected to be exposed to novaluron treatments in small, contained water bodies, and both pelagic and benthic invertebrates are at risk from the proposed novaluron uses up to novaluron's solubility limit. The available microcosm study endpoints corroborates with the acute and chronic single species toxicity test endpoints and suggests that some aquatic invertebrates may be more sensitive to novaluron than the tested surrogate species (*i.e. Gammaridea* spp.).

All aquatic plant RQs were <0.1 for the proposed mosquito larvae use; risk quotients were also <0.1 for the proposed cricket use assuming 100% treatment of a 10 ha watersdhed. Although the assumption of an entire treated acre is conservative, RQs are explored assuming that EECs rise to the concentration of novaluron's solubility limit (this is equivalent to tripling the current peak EEC). RQs for nonvascular and vascular listed and nonlisted plant species would then still be <0.1, the same RQ values calculated for the proposed treatment to contained, small water bodies.

5.2.2 Risks to Terrestrial Organisms

Acute risk from dietary exposure to novaluron is not expected for birds or mammals based on acute toxicity data. In an available 8-day dietary toxicity study with bobwhite quail (MRID 45499002), sublethal effects were observed at the highest concentration tested (5200 mg a.i/kg diet). The study NOAEC based of these sublethal effects was 2610 mg a.i./kg diet. A comparison of this toxicity endpoint to the highest modeled dietary EEC for a 20g bird (218 mg a.i./kg dietary item) indicates that the highest modeled EEC is less than one tenth of the dietary rate; risk to Federally listed avian species is not expected. However no data exists on passeriforms, a potentially more sensitive taxon than the surrogate species tested, and thus acute risk to birds is presumed.

For the proposed use on crickets chronic adverse effects to birds are expected for all herbivorous, insectivorous, and granivorous birds (dietary RQs ranged from 1.39-22.3). Risk quotients for chronic dietary exposures to mammals also exceeded the Agency's LOC for the proposed use on crickets (does-based RQs $\leq$ 1.28). Based on the magnitude of the chronic avian RQs, a bird that obtained 5% of its dietary needs from novaluron treated areas would still consume a quantity of novaluron that exceeds the Agency's level of concern. For the proposed spray use of novaluron, where applications may not be contiguous over dietary items, adverse effects to birds are still expected. Based on the magnitude of the chronic mammal RQs, a mammal that obtained less than 100% of its dietary needs from novaluron treated areas would be less likely to be at chronic risk from the propsed novaluron spray uses.

Risks to birds and mammals from the proposed pellet/rod novaluron products are expected to be low. The proposed pellets/rods are composed primarily of wax, which are

anticipated to be unappealing to terrestrial wildlife as a dietary item or dietary aid (*i.e.* grit used by birds to grind food). Further, acute dietary effects to birds and mammals are not expected based on acute toxicity data. Thus, risk from incidental consumption is discountable.

Risks to terrestrial invertebrates and beneficial insects was qualitatively assessed. Based on novaluron's mode of action and the submitted toxicity data on adult honey bees, the potential risk of novaluron to adult pollinators and other adult beneficial insects is expected to be low. The data on earthworms also suggests that risk of novaluron toxicity to earthworms and other terrestrial invertebrates at certain life stages is low. Based on available field studies, transient effects on brood and adult life stages occurred in insect species exposed to environmentally relevant concentrations of novaluron. Based on the open literature studies with *M. rotundata*, significant development effects occurred in alfalfa leadcutting bee pupae at environmental concentrations expected from the proposed new uses of novaluron. For a solitary bee, reproductive effects that effectively prohibit development can have significant effects on the long-term success of a species. Because the proposed outdoor application rate on the RIMON® 10EC label is not limited spatially or temporally, potential application may exceed the rate evaluated in these studies; further, the RIMON® 10EC label does not restrict application on flowering plants. Thus, adverse effects to beneficial insects and all terrestrial invertebrates are expected, but the magnitude and spread of the toxicological effects to this taxon are uncertain.

Available toxicity data on earthworms indicate that chlorophenyl urea is at least slightly more toxic to earthworms than novaluron. Adverse effects to beneficial insects and all terrestrial invertebrates from chlorophenyl urea toxicity are presumed.

As described in the Risk Estimation, adverse effects to terrestrial plants are presumed from exposures to the proposed spray applications of novaluron to control crickets; risks to terrestrial plants from exposure to the proposed new pellet and rod formulations of novaluron were not assessed because exposure is expected to be negligible. However, indirect adverse effects to listed terrestrial plants (*e.g.* seed dispersal) are expected for all proposed novaluron uses from the direct adverse effects on invertebrate and vertebrate populations.

5.2.3 Bioaccumulation Assessment

Novaluron has shown to have a high bioaccumulation potential. A bioconcentration study (MRID 45638215) using bluegill sunfish reported the highest mean bioconcentration factor in whole fish of 14,431 L/kg w.w. Therefore, consumption of aquatic organisms that have accumulated novaluron may serve as an additional exposure route for higher trophic level organisms. Potential risks to birds and mammals that consume aquatic organisms were evaluated using the KABAM model (v 1.0). Inputs to the model are summarized below (**Tables 24 and 25**).

Table 24. Chemical Characteristics of Novaluron for Input into KABAM_v.1.0		
Characteristic	**Value**	**Comments/Guidance**

Pesticide Name	**Novaluron**	
Log K_{OW}	**4.3**	Enter value from acceptable or supplemental study submitted by registrant or available in scientific literature.
K_{OW}	**19953**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
K_{OC} (L/kg OC)	**5899**	Input value used in PRZM/EXAMS to derive EECs. Follow input parameter guidance for deriving this parameter value (USEPA 2002).
Time to steady state (T_S; days)	**8**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
Pore water EEC (µg/L)	**3**	Enter value generated by PRZM/EXAMS benthic file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the pore water of the sediment. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. Select the EEC generated by PRZM/EXAMS which has an averaging period closest to the time to steady state calculated above. In cases where the time to steady state exceeds 365 days, the user should select the EEC representing the average of yearly averages. The peak EEC should not be used.
Water Column EEC (µg/L)	**3**	Enter value generated by PRZM/EXAMS water column file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the water column. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. The averaging period used for the water column EEC should be the same as the one selected for the pore water EEC (discussed above).

Table 25. Mammalian and Avian Toxicity Data of Novaluron for Input into Kabam_v.1.0

Animal	Measure of effect (units)	Value	Species	If selected species is "other," enter body weight (in kg) here.
Avian	LD_{50} (mg/kg-bw)	>2000	mallard duck	
	LC_{50} (mg/kg-diet)	>5200	Northern bobwhite quail	

	NOAEC (mg/kg-diet)	9.8	mallard duck	
	Mineau Scaling Factor	1.15	Default value for all species is 1.15 (for chemical specific values, see Mineau et al. 1996).	
Mammalian	LD_{50} (mg/kg-bw)	>5000	laboratory rat	
	LC_{50} (mg/kg-diet)	N/A	other	
	Chronic Endpoint	1000	laboratory rat	
	units of chronic endpoint*	ppm		

*ppm = mg/kg-diet

KABAM Modeling Results

All RQs for birds and mammals that consume aquatic organisms are below concern levels at novaluron's solubility limit (**Table 26**). Therefore, although the BCF of novaluron is consistent with highly bioaccumulative chemicals, it does not appear that risk exceeds concern levels to non-target birds or mammals that consume contaminated aquatic organisms under labeled use rates.

Table 26. Calculation of RQ values for mammals and birds consuming fish contaminated by Novaluron.

	Acute		Chronic	
Wildlife Species	**Dose Based**	**Dietary Based**	**Dose Based**	**Dietary Based**
Mammalian				
fog/water shrew	<0.000	N/A	0.013	0.002
rice rat/star-nosed mole	<0.000	N/A	0.015	0.002
small mink	<0.000	N/A	0.019	0.003
large mink	<0.000	N/A	0.022	0.003
small river otter	<0.000	N/A	0.023	0.003
large river otter	<0.000	N/A	0.027	0.003
Avian				
sandpipers	<0.002	<0.000	N/A	0.231
cranes	<0.000	<0.000	N/A	0.235
rails	<0.001	<0.001	N/A	0.269
herons	<0.000	<0.001	N/A	0.275

small osprey	<0.000	<0.001	N/A	0.318
white pelican	<0.000	<0.001	N/A	0.339

6. THREATENED AND ENDANGERED SPECIES CONCERNS

Based on the endangered species LOC exceedances, concerns for direct effects on a chronic exposure basis have been identified for all animal taxa except freshwater fish and aquatic-phase amphibians; concern for terrestrial plants was identified due to lack of data (**Table 27).** There is also a concern for indirect effects to all species that have obligate feeding requirements or general dependency on the organisms directly affected as a resource.

Table 27. Listed Species Risks Associated with the Proposed New Uses of Novaluron

Listed Taxa	Direct Effects	Indirect Effects
Terrestrial and semi-aquatic plants – monocots	**Yes**[1]	**Yes**
Terrestrial and semi-aquatic plants – dicots	**Yes**[1]	**Yes**
Birds	**Yes**	**Yes**
Terrestrial phase amphibians	**Yes**	**Yes**
Reptiles	**Yes**	**Yes**
Mammals	**Yes**	**Yes**
Terrestrial insects	**Yes**	**Yes**
Aquatic plants	No	**Yes**
Freshwater fish	No	**Yes**
Aquatic phase amphibians	No	**Yes**
Freshwater invertebrates	**Yes**	**Yes**
Mollusks	**Yes**	**Yes**
Marine/estuarine fish	**Yes**[1]	**Yes**
Marine/estuarine invertebrates	**Yes**	**Yes**

[1] Risk to taxon based on direct effects is presumed due to lack of data.

6.1 Listed Species Occurrence Associated with Novaluron Use

The goal of the co-location analysis is determine whether sites of pesticide use are geographically associated with known locations of listed species [following the convention of the Services, the word 'species' in this assessment may apply to a 'species', 'subspecies', or an Evolutionary Significant Unit (ESU)]. At the screening level, this analysis is accomplished using the LOCATES database (version 2.13). The

database uses location information for listed species at the county level and compares it to agricultural census data (from 2007) for crop production at the same county level of resolution. The product is a listing of Federally-listed species that are located in counties known to produce the crops upon which the pesticide will be used.

Novaluron is proposed for use on uncultivated agriculture and non-agricultural areas. Because LOCATES database contains only crop location data, state- and county-level summaries from LOCATES are not provided. Based on the extent of proposed uses and the potential for direct and indirect effects, all listed species occurring nationwide may be potentially affected by a new registration of novaluron. A summary of listed species that may be directly or indirectly affected by the proposed new uses of novaluron is provided in **Appendix G**. Based the results of the LOCATES database query (performed on 4/11/2011), there are a total of 1396 listed species from all taxa associated with counties where novaluron may potentially be used nationwide for uncultivated-agricultural and non-agricultural purposes.

7. REFERENCES

Des Lauriers, A., J. Li, K. Sze., S.L. Baker, G. Gris, and J. Chan. 2006. A field study of the use of methoprene for West Nile virus mosquito control. J. Environ. Eng. Sci. **5**: 517-527 (2006). Available on the NRC Research Press Website at http://jees.nrc.ca/.

U.S. EPA. 1993. Wildlife Exposure Factors Handbook. Volume I of II. EPA/600/R-93/187a. Office of Research and Development, Washington, D. C. 20460. EPA/600/R-93/187a.

U.S. EPA. 1998. Guidance for Ecological Risk Assessment. Risk Assessment Forum. EPA/630/R-95/002F, April 1998.

U.S. EPA. 2002. Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides Input Parameter Guidance. Version II February 28, 2002. U.S. Environmental Protection Agency, Office of Pesticide Programs, Environmental Fate and Effects Division.

U.S. EPA. 2004. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs. Office of Prevention, Pesticides, and Toxic Substances. Office of Pesticide Programs. Washington, D.C. January 23, 2004.

U.S. EPA. 2004. Novaluron. Report of the Metabolism Assessment review Committee (MARC). Office of Prevention, Pesticides, and Toxic Substances. Office of Pesticide Programs. Washington, D.C. February 3, 2004.

Willis, G.H., and L.L. McDowell. 1987. Pesticide Persistence on Foliage in Reviews of Environmental Contamination and Toxicology. **100**: 23-73.

APPENDIX A Ecotoxicity Profile for Novaluron and Degradates

MRID	Species	Guideline	Test	Chemical	Classification	Endpoints
Fish						
45638210	Sheepshead minnow (*Cyprinodon variegates*)	850.1075	96-hr acute	Technical Grade Active Ingredient (Novaluron)	Supplemental	96-hr LC_{50} > 2 µg a.i No mortality or sublethal
45499004	Rainbow trout (*Salmo gairdneri*)	850.1075	96-hr acute	Technical Grade Active Ingredient (Novaluron)	Supplemental	96-hr LC_{50} >980 µg a No mortality or sublethal
45499005	Bluegill sunfish (*Lepomis macrochirus*)	850.1075	96-hr acute	Technical Grade Active Ingredient (Novaluron)	Supplemental	96-hr LC_{50} >960 µg No mortality or sublethal
45638216	Rainbow Trout (*Salmo gairdneri*)	non-guideline	28-day subchronic	Technical Grade Active Ingredient (Novaluron)	Supplemental	NOAEC = 6.16 µg a. LOAEC > 6.16 µg a. Terminal growth and mo
45638314	Rainbow Trout (*Salmo gairdneri*)	850.1075	96-hr acute	RIMON® SUPRA 10EC	Acceptable	96-hr LC_{50} = 5,740 µg Sublethal effects not
45638406	Rainbow Trout (*Salmo gairdneri*)	non-guideline	28-day subchronic	RIMON® SUPRA 10EC	Supplemental	NOAEC = 111.3 µg a (NOAEC =1210 µg for LOAEC = 310 µg a.i (LOAEC = 3370 µg for Mortality and Sublethal Effects not
45499006	Rainbow Trout (*Salmo gairdneri*)	850.1075	96-hr acute	275-352 I (Chlorophenyl)	Acceptable	96-hr LC_{50} = 530 µg a NOAEC = 144 µg a.i
Aquatic Invertebrates						
45885801	Multiple species	non-guideline	Mesocosm study	Technical Grade Active Ingredient (Novaluron)	Supplemental	
47651902	*Chironomus riparius*	non-guideline	28-day emergence test	Technical Grade Active Ingredient (Novaluron)	Supplemental	Pore Water NOAEC = 0.13 µg a. LOAEC = 0.26 µg a.
45628212	Mysid Shrimp	850.1025	Life Cycle	Technical Grade Active Ingredient (Novaluron)	Acceptable	NOAEC = 0.03 µg a. LOAEC = 0.06 µg a. Reduction in terminal ma weight
45638211; 46581401*	*Daphnia magna*	850.1010	21-day chronic	Technical Grade Active Ingredient (Novaluron)	Acceptable	NOAEC = 0.03 µg a. LOAEC = 0.06 µg a. Reduction in parental surv offspring productio
45638209	Mysid Shrimp	850.1025	96-hr acute	Technical Grade Active Ingredient (Novaluron)	Acceptable	96-hr LC_{50} = 0.13 µg a Sublethal effects not

45638208	Mollusk deposition Study	850.1035	96-hr acute	Technical Grade Active Ingredient (Novaluron)	Acceptable	96-hr EC_{50} = 1.5 µg Sublethal effects not
45499007	*Daphnia magna*	850.1010	48-hr acute	275-352 I (Chlorophenyl)	Supplemental	48-hr EC_{50} = 1910 µg NOAEC = 690 µg a.
46086203	Mysid Shrimp	850.1025	96-hr acute	RIMON® SUPRA 10EC	Acceptable	96-hr LC_{50} = 0.12 µg a (48-hr EC_{50} = 1.28 µg fo Sublethal effects not
45638413	*Daphnia magna*	850.1010	48-hr Acute	RIMON® SUPRA 10EC	Acceptable	48-hr EC_{50} = 0.4 µg a (48-hr EC_{50} = 4.31 µg fo Sublethal effects not
Plants						
45638221	*Selenastrum capriconutum*	850.5400	96-hr	Technical Grade Active Ingredient (Novaluron)	Supplemental	EC_{50} >9,680 µg a.i. NOAEC = 9,680 µg a
45638223	*Lemna minor*	850.4400	14-day	RIMON® SUPRA 10EC	Acceptable	EC_{50} >75.4 µg a.i./ NOAEC = 75.4 µg a.
45638411	*Selenastrum capricornutum*	850.5400	96-hr	RIMON® SUPRA 10EC	Supplemental	EC_{50} = 3549 µg a.i. NOAEC = 2475 µg a
45638222	*Selenastrum capricornutum*	850.5400	96-hr	275-352 I (Chlorophenyl)	Supplemental	EC_{50} = 330 µg met/ NOAEC = 105 µg me
Birds						
45638219	Mallard Duck (*Anas platyrhynchos*)	850.2300	1-gen Reproduction	Technical Grade Active Ingredient (Novaluron)	Acceptable	NOAEC = 9.8 mg a.i./k LOAEC = 30 mg a.i./k
45638218	Bobwhite quail (*Colinus virginianus*)	850.2300	1-gen reproduction	Technical Grade Active Ingredient (Novaluron)	Acceptable	NOAEC = 301 mg a.i./k LOAEC = 1013 mg a.i./
45499003	Mallard Duck (*Anas platyrhynchos*)	850.2200	Subacute Dietary	Technical Grade Active Ingredient (Novaluron)	Acceptable	LC_{50} > 5310 mg a.i./kg NOAEC = 5310 mg a.i./
45499002	Bobwhite quail (*Colinus virginianus*)	850.2200	Subacute Dietary	Technical Grade Active Ingredient (Novaluron)	Acceptable	LC_{50} > 5200 mg/kg d NOAEC = 2610 mg a.i./
45499001	Mallard Duck (*Anas platyrhynchos*)	850.2100	Acute Oral	Technical Grade Active Ingredient (Novaluron)	Supplemental	LD_{50} > 2000 mg a.i./kg NOAEC = 2000 mg a.i./
45476801	Bobwhite quail (*Colinus virginianus*)	850.2100	Acute Oral	Technical Grade Active Ingredient (Novaluron)	Acceptable	LD_{50} > 2000 mg a.i./kg NOAEC = 2000 mg a.i./
Mammals						
44961001	Laboratory rat (*Rattus novegicus*)	870.1100	Acute Oral	Technical Grade Active Ingredient	Acceptable	14-day LD_{50} >5000 mg a
45651505	Laboratory rat (*Rattus novegicus*)	870.3800	2-Generation Reproduction	Technical Grade Active Ingredient	Acceptable	NOAEC = 1000 mg ai/k LOAEC = 4000 mg ai/k

Terrestrial Invertebrates						
45638409	Honey Bee (*Apis melifera*)	850.3040	Field Test	RIMON® SUPRA 10EC	Supplemental	
45638408	Honey Bee (*Apis melifera*)	850.3020	Acute contact (and acute oral)	RIMON® SUPRA 10EC	Acceptable (Supplemental)	CONTACT and ORA 48-hr LD_{50} >200 µg a.i NOAEC = 200 µg a.i.
45638407	Honey Bee (*Apis melifera*)	850.3040	Field Test	RIMON® SUPRA 10EC	Supplemental	
45638225	Earthworm (*Eisenia foetida*)	850.6200	14-day Subchronic	275-352 I (Chlorophenyl)	Supplemental	LC_{50} = 447 mg a.i./kg NOAEC = 171 mg a.i./k
45638224	Earthworm (*Eisenia foetida*)	850.6200	14-day Subchronic	Technical Grade Active Ingredient (Novaluron)	Supplemental	LC_{50} > 1000 mg a.i./kg NOAEC = 1000 mg a.i./
45638220	Honey Bee (*Apis melifera*)	850.3020	Acute Cont act (acute oral)	Technical Grade Active Ingredient (Novaluron)	Acceptable (Supplemental)	CONTACT and ORA LD_{50} > 100 µg a.i./b NOAEC = 100 µg a.i.

APPENDIX B Previous EFED Risk Assessments for Novaluron

Table 3. Previous Section 3 and Section 18 Ecological Risk Assessment Actions and Assessed Uses for Novaluron

Crop	Single Application Rate (lb ai/A)	Number of Applications (Application Interval in Days)	Action/DP Barcode/Date	Risk Conclusions
Ornamentals and Greenhouse	0.17	2 (30)	Section 3 New Chemical Registration D318619	No risk concerns exist for acute or chronic direct effects to listed or non-listed fish in freshwater or estuarine/marine environments. However, greatest risk from novaluron use is to invertebrates in both media. No acute effects are expected on birds, mammals, and plants. Chronic effects are possible on birds and mammals. Adverse impacts are possible on developing insects due to the novaluron's mode of action, which is targeted against chitin development and cuticle formation of insect larvae.
Pome fruit Cotton Potato	0.32 0.09 0.08	3 (10 – 14) 3 (7 – 14) 3 (10 – 14)	Section 3 New Use Registration DP285477, 285479, 287624, 297230 6/14/04	
Head and Stem Brassica	0.04 – 0.08	3 (up to 0.16 lb ai/A) (7 – 14)	Section 3 New Use Registration DP321545 2/2/06	
Sugarcane	0.08	5 (10 – 14)	Section 18 Emergency Use Exemption DP329703 6/27/06	
Head and Stem Brassica Tomato Sugarcane	0.08 0.08 0.08 (ground and aerial)	3 3 5 (7 – 10)	Section 3 New Use Registration for tomato and sugarcane and increase in maximum use rates for brassica vegetables DP340579, 340581, 340583, 340672 2/5/2008	
Strawberry	0.08 (ground)	3 (7 – 10)	Section 18 Emergency Use Exemption in Florida	

			D357484 10/30/2008	
Stone Fruit Bushberry Brassica Leafy Greens Turnip Greens	0.32 0.20 0.08	3 (7-14) 3 (10-14) 3 (7-14)	Section3 New Use Registration D358376 04/14/2009	
Strawberry	0.078	3 (7-10)	Section 18 Emergency Use Exemption in California D364391 06/02/2009	Novaluron use on strawberry has the potential to cause adverse acute and chronic impacts to both listed and non-listed freshwater and estuarine/marine invertebrates. No acute adverse effects expected for fish, birds, or mammals. No chronic adverse effects expected for fish or mammals. Chronic risk expected to birds. Novaluron is not expected to cause adverse effects to terrestrial aquatic plants. Adverse impacts are possible on developing insects.
Sorghum Fruiting Veg. Curcurbit Veg. Low Growing Berry Subgroup Snap and Dry Bean Swiss Chard	0.078	3 (7-14)	Section3 New Use Registration D364309 & D364313 11/27/2009	Novaluron use has the potential to cause adverse acute and chronic impacts to both listed and non-listed freshwater and estuarine/marine invertebrates. No acute adverse effects expected for fish, birds, or mammals. No chronic adverse effects expected for fish or mammals. Chronic risk expected to birds. Risk to terrestrial plants is assumed.
Sweet Corn	0.078	5 (7)	Section3 New Use Registration D378620 11/18/2010	Novaluron use has the potential to cause adverse acute and chronic impacts to both listed and non-listed freshwater and estuarine/marine invertebrates. No acute adverse effects expected for fish, birds, or mammals. No chronic adverse effects expected for fish; chronic risk expected for birds and mammals. Risk to aquatic plants not expected; risk to terrestrial plants presumed due to lack of data.

APPENDIX C Integrate of Exposure and Effects

Table C-1 lists the measures of environmental exposure and ecological effects used to assess the potential risks of novaluron to non-target organisms. The risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. The methods used to assess the risk are consistent with those outlined in the document "Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs" (USEPA 2004).

Table C-1. Agency Risk Quotient (RQ) Metrics and Levels of Concern (LOC) Per Risk Class.

RISK CLASS	RISK DESCRIPTION	RQ	LOC
Aquatic Animals (fish and invertebrates)			
Acute	Potential for effects to non-listed animals from acute exposures	Peak EEC/LC_{50}[1]	0.5
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	Peak EEC/LC_{50}[1]	0.1
Acute Listed Species	Listed species may be potentially affected by acute exposures	Peak EEC/LC_{50}[1]	0.05
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	60-day EEC/NOAEC (fish)	1
		21-day EEC/NOAEC (invertebrates)	
Aquatic Plants			
Non-Listed	Potential for effects to non-listed plants from exposures	Peak EEC/LC_{50}[1]	1
Listed	Potential for effects to listed plants from exposures	Peak EEC/NOAEC	1
Terrestrial Animals (mammals and birds)			
Acute	Potential for effects to non-listed animals from acute exposures	EEC/LC_{50} (Dietary)	0.5
		EEC/LD_{50} (Dose)	
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	EEC/LC_{50} (Dietary)	0.2
		EEC/LD_{50} (Dose)	
Acute Listed Species	Listed species may be potentially affected by acute exposures	EEC/LC_{50} (Dietary)	0.1
		EEC/LD_{50} (Dose)	
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	EEC/NOAEC	1
Terrestrial and Semi-Aquatic Plants			
Non-Listed	Potential for effects to non-target, non-listed plants from exposures	EEC/ EC_{25}	1
Listed Plant	Potential for effects to non-target, listed plants from exposures	EEC/ NOAEC	1
		EEC/ EC_{05}	

[1] LC_{50} or EC_{50}.

APPENDIX D Calculation of RIMON® SUPRA 10EC Application Rates for Perimeter and Spot Treatments

Calculation for the maximum application of diluted RIMON® SUPRA 10EC for outdoor perimeter and spot treatments:

APPENDIX E Example PRZM/EXAMS

PRZM/EXAMS PA Turf Output File (10% of a Watershed Treated)

stored as PATf10.out
Chemical: Novaluron
PRZM environment: PAturfSTD.txt modified Thuday, 23 February 2006 at 17:55:08
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 05:14:08
Metfile: w14751.dvf modified Tueday, 26 August 2008 at 05:15:00
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.04815	0.03743	0.01753	0.008674	0.006347	0.001813
1962	0.01099	0.008603	0.004065	0.002021	0.001646	0.0008223
1963	0.0005617	0.0005561	0.0005427	0.000511	0.0004505	0.0001958
1964	0.00376	0.002905	0.001318	0.0006509	0.0004916	0.0001587
1965	0.001562	0.001213	0.000558	0.0002927	0.0002288	9.107e-005
1966	0.04129	0.03241	0.01534	0.007242	0.005518	0.001492
1967	0.0294	0.02299	0.01077	0.006351	0.004698	0.001896
1968	0.008925	0.007041	0.003359	0.001556	0.001166	0.0005301
1969	0.1339	0.1038	0.06	0.02702	0.01975	0.005747
1970	0.01323	0.01053	0.007153	0.004475	0.00334	0.002023
1971	0.07568	0.05946	0.02992	0.01466	0.01082	0.003154
1972	1.542	1.206	0.5862	0.2652	0.1929	0.05541
1973	0.018	0.01773	0.01671	0.01625	0.01491	0.006071
1974	0.008069	0.006435	0.003333	0.001951	0.001674	0.0006957
1975	0.09818	0.077	0.03627	0.01644	0.01197	0.003779
1976	0.00867	0.006764	0.003186	0.001534	0.001312	0.0008605
1977	0.00039	0.0003883	0.0003797	0.0003579	0.0003131	0.0001277
1978	0.05153	0.04016	0.0265	0.01236	0.008992	0.00257
1979	0.01706	0.01347	0.006519	0.003047	0.002424	0.001044
1980	0.0003414	0.0003379	0.0003253	0.0003152	0.0002893	0.0001251

1981	0.00564	0.004386	0.002398	0.001188	0.0008937	0.0002846
1982	0.02271	0.01819	0.009078	0.004238	0.003115	0.0009555
1983	0.0003041	0.0003003	0.0002847	0.0002528	0.000227	9.469e-005
1984	0.02153	0.01713	0.01065	0.005144	0.003764	0.001089
1985	0.0009828	0.0007845	0.0004028	0.0003898	0.0003478	0.0001733
1986	0.02873	0.02285	0.01125	0.006347	0.004775	0.00143
1987	0.04759	0.03712	0.01721	0.007645	0.005617	0.001934
1988	0.02686	0.02081	0.009509	0.004225	0.003088	0.001074
1989	0.03005	0.02373	0.01185	0.008313	0.00647	0.002073
1990	0.01121	0.008721	0.004047	0.002368	0.001805	0.0007658

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly	
0.032258064516129	1.542	1.206	0.5862	0.2652	0.1929	0.05541	
0.0645161290322581	0.1339	0.1038	0.06	0.02702	0.01975	0.006071	
0.0967741935483871	0.09818	0.077	0.03627	0.01644	0.01491	0.005747	
0.129032258064516	0.07568	0.05946	0.02992	0.01625	0.01197	0.003779	
0.161290322580645	0.05153	0.04016	0.0265	0.01466	0.01082	0.003154	
0.193548387096774	0.04815	0.03743	0.01753	0.01236	0.008992	0.00257	
0.225806451612903	0.04759	0.03712	0.01721	0.008674	0.00647	0.002073	
0.258064516129032	0.04129	0.03241	0.01671	0.008313	0.006347	0.002023	
0.290322580645161	0.03005	0.02373	0.01534	0.007645	0.005617	0.001934	
0.32258064516129	0.0294	0.02299	0.01185	0.007242	0.005518	0.001896	
0.354838709677419	0.02873	0.02285	0.01125	0.006351	0.004775	0.001813	
0.387096774193548	0.02686	0.02081	0.01077	0.006347	0.004698	0.001492	
0.419354838709677	0.02271	0.01819	0.01065	0.005144			

0.003764 0.00143
0.451612903225806 0.02153 0.01773 0.009509 0.004475
0.00334 0.001089
0.483870967741936 0.018 0.01713 0.009078 0.004238 0.003115
0.001074
0.516129032258065 0.01706 0.01347 0.007153 0.004225
0.003088 0.001044
0.548387096774194 0.01323 0.01053 0.006519 0.003047
0.002424 0.0009555
0.580645161290323 0.01121 0.008721 0.004065 0.002368
0.001805 0.0008605
0.612903225806452 0.01099 0.008603 0.004047 0.002021
0.001674 0.0008223
0.645161290322581 0.008925 0.007041 0.003359 0.001951
0.001646 0.0007658
0.67741935483871 0.00867 0.006764 0.003333 0.001556
0.001312 0.0006957
0.709677419354839 0.008069 0.006435 0.003186 0.001534
0.001166 0.0005301
0.741935483870968 0.00564 0.004386 0.002398 0.001188
0.0008937 0.0002846
0.774193548387097 0.00376 0.002905 0.001318 0.0006509
0.0004916 0.0001958
0.806451612903226 0.001562 0.001213 0.000558 0.000511
0.0004505 0.0001733
0.838709677419355 0.0009828 0.0007845 0.0005427 0.0003898
0.0003478 0.0001587
0.870967741935484 0.0005617 0.0005561 0.0004028 0.0003579
0.0003131 0.0001277
0.903225806451613 0.00039 0.0003883 0.0003797 0.0003152
0.0002893 0.0001251
0.935483870967742 0.0003414 0.0003379 0.0003253 0.0002927
0.0002288 9.469e-005
0.967741935483871 0.0003041 0.0003003 0.0002847 0.0002528
0.000227 9.107e-005

0.1 0.09593 0.075246 0.035635 0.016421 0.014616
0.0055502

Average of yearly averages: 0.003282662

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: PATf10
Metfile: w14751.dvf
PRZM scenario: PAturfSTD.txt

EXAMS environment file: pond298.exv

Chemical Name: Novaluron

Description	Variable Name		Value	Units	Comments
Molecular weight		mwt	492.7	g/mol	
Henry's Law Const.		henry		atm-m^3/mol	
Vapor Pressure		vapr	1.2e-7	torr	
Solubility	sol	0.003	mg/L		
Kd	Kd	165	mg/L		
Koc	Koc		mg/L		
Photolysis half-life		kdp	0	days	Half-life
Aerobic Aquatic Metabolism		kbacw	21.9	days	Halfife
Anaerobic Aquatic Metabolism			kbacs	56.9	days Halfife
Aerobic Soil Metabolism			asm	15.6	days Halfife
Hydrolysis:	pH 7	0	days	Half-life	
Method:	CAM	2	integer	See PRZM manual	
Incorporation Depth:		DEPI	0	cm	
Application Rate:		TAPP	0.102	kg/ha	
Application Efficiency:			APPEFF	1.0	fraction
Spray Drift	DRFT	0.0	fraction of application rate applied to pond		
Application Date		Date	15-06	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA				
	IPSCND	1			
	UPTKF				
Record 18:	PLVKRT				
	PLDKRT				
	FEXTRC	0.5			
Flag for Index Res. Run		IR	EPA Pond		
Flag for runoff calc.		RUNOFF	none	none, monthly or total(average of entire run)	

APPENDIX F T-REX Example Output

Chemical Identity and Application Information

Chemical Name:	Novaluron
Use:	Residential Use
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lbs/A):	0.91
Half-life (days):	35
Application Interval (days):	0
Number of Applications:	1

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

Table X. Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	0.00	248.74	#DIV/0!	114.00	#######	139.91	######	15.55	######	3.45	#####
100	0.00	141.84	#DIV/0!	65.01	#######	79.78	######	8.86	######	1.97	#####
1000	0.00	63.50	#DIV/0!	29.11	#######	35.72	######	3.97	######	0.88	#####

Table X. Upper Bound Kenaga, Subacute Avian Dietary Based Risk Quotients

	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	218.40	#######	100.10	#######	122.85	#DIV/0!	13.65	#####

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients								
NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
10	218.40	22.29	100.10	10.21	122.85	12.54	13.65	1.39

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients											
Size Class (grams)	Adjusted LD50	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	0.00	208.23	#DIV/0!	95.44	#####	117.13	#####	13.01	#####	2.89	#####
35	0.00	143.91	#DIV/0!	65.96	#####	80.95	#####	8.99	#####	2.00	#####
1000	0.00	33.37	#DIV/0!	15.29	#####	18.77	#####	2.09	#####	0.46	#####

Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients								
LC50 (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	218.40	#####	100.10	#####	122.85	#DIV/0!	13.65	#####

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients	
NOA	EECs and RQs

EC (ppm)	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
1000	218.40	0.22	100.10	0.10	122.85	0.12	13.65	0.01

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients

Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	163.08	208.23	1.28	95.44	0.59	117.13	0.72	13.01	0.08	2.89	0.02
35	131.95	143.91	1.09	65.96	0.50	80.95	0.61	8.99	0.07	2.00	0.02
1000	57.07	33.37	0.58	15.29	0.27	18.77	0.33	2.09	0.04	0.46	0.01

APPENDIX G LOCATES Threatened and Endangered Species

Common Name	Scientific Name	Taxon	Status
Hawaiian picture-wing Fly	Drosophila sharpi	Insect	E
Damselfly, Flying Earwig Hawaiian	Megalagrion nesiotes	Insect	E
Damselfly, Pacific Hawaiian	Megalagrion pacificum	Insect	E
Bat, Indiana	Myotis sodalis	Mammal	E
Bear, Grizzly	Ursus arctos horribilis	Mammal	T
Deer, Columbian White-tailed	Odocoileus virginianus leucurus	Mammal	E
Deer, Key	Odocoileus virginianus clavium	Mammal	E
Ferret, Black-footed	Mustela nigripes	Mammal	E
Fox, San Joaquin Kit	Vulpes macrotis mutica	Mammal	E
Manatee, West Indian	Trichechus manatus	Mammal	E
Panther, Florida	Puma (=Felis) concolor coryi	Mammal	E
Pronghorn, Sonoran	Antilocapra americana sonoriensis	Mammal	E
Squirrel, Delmarva Peninsula Fox	Sciurus niger cinereus	Mammal	E
Wolf, Gray	Canis lupus	Mammal	E
Wolf, Red	Canis rufus	Mammal	E
Whale, Blue	Balaenoptera musculus	Mammal	E
Whale, Bowhead	Balaena mysticetus	Mammal	E
Whale, Finback	Balaenoptera physalus	Mammal	E
Whale, Gray	Eschrichtius robustus	Mammal	E
Whale, Humpback	Megaptera novaeangliae	Mammal	E
Whale, North Atlantic right	Eubalaena glacialis (incl. australis)	Mammal	E
Whale, Sei	Balaenoptera borealis	Mammal	E
Whale, Sperm	Physeter catodon (=macrocephalus)	Mammal	E
Bat, Hawaiian Hoary	Lasiurus cinereus semotus	Mammal	E
Kangaroo Rat, Morro Bay	Dipodomys heermanni morroensis	Mammal	E
Mouse, Salt Marsh Harvest	Reithrodontomys raviventris	Mammal	E
Jaguar	Panthera onca	Mammal	E
Prairie Dog, Utah	Cynomys parvidens	Mammal	T
Bat, Gray	Myotis grisescens	Mammal	E
Jaguarundi, Gulf Coast	Herpailurus (=Felis) yagouaroundi cacomitli	Mammal	E
Jaguarundi, Sinaloan	Herpailurus (=Felis) yagouaroundi tolteca	Mammal	E
Seal, Hawaiian Monk	Monachus schauinslandi	Mammal	E

Lynx, Canada	Lynx canadensis	Mammal	T
Bat, Ozark Big-eared	Corynorhinus (=Plecotus) townsendii ingens	Mammal	E
Bat, Little Mariana Fruit	Pteropus tokudae	Mammal	E
Bat, Mariana Fruit (=Mariana Flying Fox)	Pteropus mariannus mariannus	Mammal	T
Bat, Virginia Big-eared	Corynorhinus (=Plecotus) townsendii virginianus	Mammal	E
Vole, Amargosa	Microtus californicus scirpensis	Mammal	E
Rice Rat (=Silver Rice Rat)	Oryzomys palustris natator	Mammal	E
Ocelot	Leopardus (=Felis) pardalis	Mammal	E
Mouse, Key Largo Cotton	Peromyscus gossypinus allapaticola	Mammal	E
Woodrat, Key Largo	Neotoma floridana smalli	Mammal	E
Caribou, Woodland	Rangifer tarandus caribou	Mammal	E
Mouse, Choctawhatchee Beach	Peromyscus polionotus allophrys	Mammal	E
Mouse, Perdido Key Beach	Peromyscus polionotus trissyllepsis	Mammal	E
Bear, Louisiana Black	Ursus americanus luteolus	Mammal	T
Fox, San Miguel Island	Urocyon littoralis littoralis	Mammal	E
Fox, Santa Catalina Island	Urocyon littoralis catalinae	Mammal	E
Fox, Santa Cruz Island	Urocyon littoralis santacruzae	Mammal	E
Fox, Santa Rosa Island	Urocyon littoralis santarosae	Mammal	E
Kangaroo Rat, Fresno	Dipodomys nitratoides exilis	Mammal	E
Kangaroo Rat, Giant	Dipodomys ingens	Mammal	E
Kangaroo Rat, Stephens'	Dipodomys stephensi (incl. D. cascus)	Mammal	E
Kangaroo Rat, Tipton	Dipodomys nitratoides nitratoides	Mammal	E
Mouse, Alabama Beach	Peromyscus polionotus ammobates	Mammal	E
Squirrel, Carolina Northern Flying	Glaucomys sabrinus coloratus	Mammal	E
Squirrel, Mount Graham Red	Tamiasciurus hudsonicus grahamensis	Mammal	E
Otter, Southern Sea	Enhydra lutris nereis	Mammal	T
Seal, Guadalupe Fur	Arctocephalus townsendi	Mammal	T
Seal, spotted	Phoca largha	Mammal	T
Rabbit, Lower Keys Marsh	Sylvilagus palustris hefneri	Mammal	E
Bat, Lesser (=Sanborn's) Long-nosed	Leptonycteris curasoae yerbabuenae	Mammal	E
Bat, Mexican Long-nosed	Leptonycteris nivalis	Mammal	E
Mountain Beaver, Point Arena	Aplodontia rufa nigra	Mammal	E

Mouse, Anastasia Island Beach	Peromyscus polionotus phasma	Mammal	E
Mouse, Pacific Pocket	Perognathus longimembris pacificus	Mammal	E
Mouse, Preble's Meadow Jumping	Zapus hudsonius preblei	Mammal	T
Mouse, Southeastern Beach	Peromyscus polionotus niveiventris	Mammal	T
Mouse, St. Andrew Beach	Peromyscus polionotus peninsularis	Mammal	E
Rabbit, Riparian Brush	Sylvilagus bachmani riparius	Mammal	E
Sheep, Peninsular Bighorn	Ovis canadensis nelsoni	Mammal	E
Sheep, Sierra Nevada Bighorn	Ovis canadensis sierrae	Mammal	E
Shrew, Buena Vista Lake Ornate	Sorex ornatus relictus	Mammal	E
Squirrel, Northern Idaho Ground	Spermophilus brunneus brunneus	Mammal	T
Vole, Florida Salt Marsh	Microtus pennsylvanicus dukecampbelli	Mammal	E
Vole, Hualapai Mexican	Microtus mexicanus hualpaiensis	Mammal	E
Woodrat, Riparian	Neotoma fuscipes riparia	Mammal	E
Sea-lion, Steller	Eumetopias jubatus	Mammal	E/T
Puma (=Cougar), Eastern	Puma (=Felis) concolor (all subsp. except coryi)	Mammal	E
Bear, American Black	Ursus americanus	Mammal	SAT
Kangaroo Rat, San Bernardino Merriam's	Dipodomys merriami parvus	Mammal	E
Rabbit, Pygmy	Brachylagus idahoensis	Mammal	E
Otter, Northern Sea	Enhydra lutris kenyoni	Mammal	T
Bear, polar	Ursus maritimus	Mammal	E
Killer whale, Southern Resident DPS	Orcinus orca	Mammal	E
'Akia Loa, Kauai (Hemignathus procerus)	Hemignathus procerus	Bird	E
'Akia Pola'au (Hemignathus munroi)	Hemignathus munroi	Bird	E
Condor, California	Gymnogyps californianus	Bird	E
Crane, Whooping	Grus americana	Bird	E
Crow, Hawaiian ('Alala)	Corvus hawaiiensis	Bird	E
Duck, Hawaiian (Koloa)	Anas wyvilliana	Bird	E
Duck, Laysan	Anas laysanensis	Bird	E
Eagle, Bald	Haliaeetus leucocephalus	Bird	T
Finch, Laysan	Telespyza cantans	Bird	E
Finch, Nihoa	Telespyza ultima	Bird	E
Goose, Hawaiian (Nene)	Branta (=Nesochen)	Bird	E

	sandvicensis		
Hawk, Hawaiian (Io)	Buteo solitarius	Bird	E
Honeycreeper, Crested ('Akohekohe)	Palmeria dolei	Bird	E
Kite, Everglades Snail	Rostrhamus sociabilis plumbeus	Bird	E
Millerbird, Nihoa	Acrocephalus familiaris kingi	Bird	E
Moorhen, Hawaiian Common	Gallinula chloropus sandvicensis	Bird	E
'O'o, Kauai (='A'a)	Moho braccatus	Bird	E
'O'u (Honeycreeper)	Psittirostra psittacea	Bird	E
Palila	Loxioides bailleui	Bird	E
Parrot, Puerto Rican	Amazona vittata	Bird	E
Parrotbill, Maui	Pseudonestor xanthophrys	Bird	E
Petrel, Hawaiian Dark-rumped	Pterodroma phaeopygia sandwichensis	Bird	E
Prairie-chicken, Attwater's Greater	Tympanuchus cupido attwateri	Bird	E
Rail, Yuma Clapper	Rallus longirostris yumanensis	Bird	E
Sparrow, Cape Sable Seaside	Ammodramus maritimus mirabilis	Bird	E
Thrush, Small Kauai (Puaiohi)	Myadestes palmeri	Bird	E
Megapode, Micronesian (La Perouse's)	Megapodius laperouse	Bird	E
Starling, Ponape Mountain	Aplonis pelzelni	Bird	E
Albatross, Short-tailed	Phoebastria (=Diomedea) albatrus	Bird	E
Bobwhite, Masked	Colinus virginianus ridgwayi	Bird	E
Curlew, Eskimo	Numenius borealis	Bird	E
Warbler, Bachman's	Vermivora bachmanii	Bird	E
Warbler (=Wood), Kirtland's	Dendroica kirtlandii	Bird	E
White-eye, Ponape greater	Rukia longirostra	Bird	E
Woodpecker, Ivory-billed	Campephilus principalis	Bird	E
Tern, California Least	Sterna antillarum browni	Bird	E
Warbler, nightingale reed (old world warbler)	Acrocephalus luscinia	Bird	E
'Akepa, Hawaii	Loxops coccineus coccineus	Bird	E
'Akepa, Maui	Loxops coccineus ochraceus	Bird	E
Creeper, Oahu (Alauwahio)	Paroreomyza maculata	Bird	E
Nuku Pu'u, Kauai	Hemignathus lucidus hanapepe	Bird	E
Nuku Pu'u, Maui	Hemignathus lucidus affinus	Bird	E
Pigeon, Puerto Rican Plain	Columba inornata wetmorei	Bird	E
Rail, California Clapper	Rallus longirostris obsoletus	Bird	E

Rail, Light-footed Clapper	Rallus longirostris levipes	Bird	E
Stilt, Hawaiian (=Ae'o)	Himantopus mexicanus knudseni	Bird	E
Thrush, Large Kauai	Myadestes myadestinus	Bird	E
Thrush, Molokai (Oloma'o)	Myadestes lanaiensis rutha	Bird	E
Woodpecker, Red-cockaded	Picoides borealis	Bird	E
Coot, Hawaiian (=Alae keo keo)	Fulica americana alai	Bird	E
Creeper, Molokai (Kakawahie)	Paroreomyza flammea	Bird	E
Crane, Mississippi Sandhill	Grus canadensis pulla	Bird	E
Nightjar, Puerto Rico	Caprimulgus noctitherus	Bird	E
Creeper, Hawaii	Oreomystis mana	Bird	E
Po'ouli	Melamprosops phaeosoma	Bird	E
Shearwater, Newell's Townsend's	Puffinus auricularis newelli	Bird	T
Shrike, San Clemente Loggerhead	Lanius ludovicianus mearnsi	Bird	E
Sparrow, San Clemente Sage	Amphispiza belli clementeae	Bird	T
Blackbird, Yellow-shouldered	Agelaius xanthomus	Bird	E
Crow, Mariana	Corvus kubaryi	Bird	E
Kingfisher, Guam Micronesian	Halcyon cinnamomina cinnamomina	Bird	E
Moorhen, Mariana Common	Gallinula chloropus guami	Bird	E
Rail, Guam	Rallus owstoni	Bird	E
White-eye, Bridled (Nossa)	Zosterops conspicillatus conspicillatus	Bird	E
White-eye, Rota Bridled	Zosterops rotensis	Bird	E
Vireo, Least Bell's	Vireo bellii pusillus	Bird	E
Stork, Wood	Mycteria americana	Bird	E
Caracara, Audubon's Crested	Polyborus plancus audubonii	Bird	T
Falcon, Northern Aplomado	Falco femoralis septentrionalis	Bird	E
Hawk, Puerto Rican Broad-winged	Buteo platypterus brunnescens	Bird	E
Hawk, Puerto Rican Sharp-shinned	Accipiter striatus venator	Bird	E
Owl, Mexican Spotted	Strix occidentalis lucida	Bird	T
Plover, Piping	Charadrius melodus	Bird	E
Plover, Western Snowy	Charadrius alexandrinus nivosus	Bird	T
Sparrow, Florida Grasshopper	Ammodramus savannarum floridanus	Bird	E
Tern, Interior (population) Least	Sterna antillarum	Bird	E
Tern, Roseate	Sterna dougallii dougallii	Bird	E
Towhee, Inyo Brown	Pipilo crissalis eremophilus	Bird	T
Vireo, Black-capped	Vireo atricapilla	Bird	E
Warbler (=Wood), Golden-cheeked	Dendroica chrysoparia	Bird	E

Scrub-Jay, Florida	Aphelocoma coerulescens	Bird	T
Crow, White-necked	Corvus leucognaphalus	Bird	E
Owl, Northern Spotted	Strix occidentalis caurina	Bird	T
Murrelet, Marbled	Brachyramphus marmoratus	Bird	T
Gnatcatcher, Coastal California	Polioptila californica californica	Bird	T
Eider, Spectacled	Somateria fischeri	Bird	T
Eider, Steller's	Polysticta stelleri	Bird	T
Swiftlet, Mariana Gray (=Vanikoro)	Aerodramus vanikorensis bartschi	Bird	E
Flycatcher, Southwestern Willow	Empidonax traillii extimus	Bird	E
Akekee	Loxops caeruleirostris	Bird	E
Kauai creeper	Oreomystis bairdi	Bird	E
Elepaio, Oahu	Chasiempis sandwichensis ibidis	Bird	E
Alligator, American	Alligator mississippiensis	Reptile	T
Lizard, Blunt-nosed Leopard	Gambelia silus	Reptile	E
Snake, San Francisco Garter	Thamnophis sirtalis tetrataenia	Reptile	E
Sea turtle, hawksbill	Eretmochelys imbricata	Reptile	E
Sea turtle, leatherback	Dermochelys coriacea	Reptile	E
Sea turtle, Kemp's ridley	Lepidochelys kempii	Reptile	E
Boa, Puerto Rican	Epicrates inornatus	Reptile	E
Sea turtle, green	Chelonia mydas	Reptile	E/T
Sea turtle, loggerhead	Caretta caretta	Reptile	T
Sea turtle, olive ridley	Lepidochelys olivacea	Reptile	T
Lizard, Island Night	Xantusia riversiana	Reptile	T
Anole, Culebra Island Giant	Anolis roosevelti	Reptile	E
Lizard, St. Croix Ground	Ameiva polops	Reptile	E
Boa, Mona	Epicrates monensis monensis	Reptile	T
Iguana, Mona Ground	Cyclura cornuta stejnegeri	Reptile	T
Rattlesnake, New Mexican Ridge-nosed	Crotalus willardi obscurus	Reptile	T
Snake, Atlantic Salt Marsh	Nerodia clarkii taeniata	Reptile	T
Turtle, Alabama Red-bellied	Pseudemys alabamensis	Reptile	E
Turtle, Flattened Musk	Sternotherus depressus	Reptile	T
Turtle, Plymouth Red-bellied	Pseudemys rubriventris bangsi	Reptile	E
Turtle, Ringed Map	Graptemys oculifera	Reptile	T
Turtle, Yellow-blotched Map	Graptemys flavimaculata	Reptile	T
Snake, Eastern Indigo	Drymarchon corais couperi	Reptile	T
Boa, Virgin Islands Tree	Epicrates monensis granti	Reptile	E
Lizard, Coachella Valley Fringe-toed	Uma inornata	Reptile	T

Crocodile, American	Crocodylus acutus	Reptile	T
Gecko, Monito	Sphaerodactylus micropithecus	Reptile	E
Skink, Blue-tailed Mole	Eumeces egregius lividus	Reptile	T
Skink, Sand	Neoseps reynoldsi	Reptile	T
Snake, Northern Copperbelly Water	Nerodia erythrogaster neglecta	Reptile	T
Tortoise, Gopher	Gopherus polyphemus	Reptile	T
Turtle, Bog	Clemmys muhlenbergii	Reptile	T
Whipsnake (=Striped Racer), Alameda	Masticophis lateralis euryxanthus	Reptile	T
Snake, Concho Water	Nerodia paucimaculata	Reptile	T
Tortoise, Desert	Gopherus agassizii	Reptile	T
Snake, Lake Erie Water	Nerodia sipedon insularum	Reptile	T
Snake, Giant Garter	Thamnophis gigas	Reptile	T
Salamander, Santa Cruz Long-toed	Ambystoma macrodactylum croceum	Amphibian	E
Salamander, Texas Blind	Typhlomolge rathbuni	Amphibian	E
Toad, Houston	Bufo houstonensis	Amphibian	E
Salamander, Desert Slender	Batrachoseps aridus	Amphibian	E
Salamander, Red Hills	Phaeognathus hubrichti	Amphibian	T
Coqui, Golden	Eleutherodactylus jasperi	Amphibian	T
Salamander, San Marcos	Eurycea nana	Amphibian	T
Toad, Puerto Rican Crested	Peltophryne lemur	Amphibian	T
Guajon	Eleutherodactylus cooki	Amphibian	T
Salamander, Barton Springs	Eurycea sosorum	Amphibian	E
Salamander, Cheat Mountain	Plethodon nettingi	Amphibian	T
Salamander, Frosted Flatwoods	Ambystoma cingulatum	Amphibian	T
Salamander, Shenandoah	Plethodon shenandoah	Amphibian	E
Salamander, Sonora Tiger	Ambystoma tigrinum stebbinsi	Amphibian	E
Toad, Wyoming	Bufo baxteri (=hemiophrys)	Amphibian	E
Salamander, California Tiger	Ambystoma californiense	Amphibian	E
Toad, Arroyo Southwestern	Bufo californicus (=microscaphus)	Amphibian	E
Frog, California Red-legged	Rana aurora draytonii	Amphibian	T
Frog, Chiricahua Leopard	Rana chiricahuensis	Amphibian	T
Frog, Mountain Yellow-legged	Rana muscosa	Amphibian	E
Frog, Dusky Gopher (Mississippi DPS)	Rana capito sevosa	Amphibian	E
Salamander, Reticulated flatwoods	Ambystoma bishopi	Amphibian	E
Chub, Humpback	Gila cypha	Fish	E
Cui-ui	Chasmistes cujus	Fish	E

Dace, Moapa	Moapa coriacea	Fish	E
Darter, Maryland	Etheostoma sellare	Fish	E
Gambusia, Big Bend	Gambusia gaigei	Fish	E
Gambusia, Clear Creek	Gambusia heterochir	Fish	E
Squawfish, Colorado	Ptychocheilus lucius	Fish	E
Poolfish, Pahrump (= Pahrump Killifish)	Empetrichthys latos	Fish	E
Pupfish, Comanche Springs	Cyprinodon elegans	Fish	E
Pupfish, Devils Hole	Cyprinodon diabolis	Fish	E
Pupfish, Owens	Cyprinodon radiosus	Fish	E
Sturgeon, Shortnose	Acipenser brevirostrum	Fish	E
Topminnow, Gila (Yaqui)	Poeciliopsis occidentalis	Fish	E
Trout, Apache	Oncorhynchus apache	Fish	T
Trout, Gila	Oncorhynchus gilae	Fish	E
Trout, Greenback Cutthroat	Oncorhynchus clarki stomias	Fish	T
Trout, Paiute Cutthroat	Oncorhynchus clarki seleniris	Fish	T
Darter, Okaloosa	Etheostoma okaloosae	Fish	E
Chub, Mohave Tui	Gila bicolor mohavensis	Fish	E
Chub, Pahranagat Roundtail	Gila robusta jordani	Fish	E
Dace, Kendall Warm Springs	Rhinichthys osculus thermalis	Fish	E
Darter, Fountain	Etheostoma fonticola	Fish	E
Darter, Watercress	Etheostoma nuchale	Fish	E
Gambusia, Pecos	Gambusia nobilis	Fish	E
Pupfish, Warm Springs	Cyprinodon nevadensis pectoralis	Fish	E
Stickleback, Unarmored Threespine	Gasterosteus aculeatus williamsoni	Fish	E
Trout, Lahontan Cutthroat	Oncorhynchus clarki henshawi	Fish	T
Woundfin	Plagopterus argentissimus	Fish	E
Darter, Snail	Percina tanasi	Fish	T
Cavefish, Alabama	Speoplatyrhinus poulsoni	Fish	E
Chub, Spotfin	Erimonax monachus	Fish	T
Darter, Leopard	Percina pantherina	Fish	T
Darter, Slackwater	Etheostoma boschungi	Fish	T
Logperch, Roanoke	Percina rex	Fish	E
Sculpin, Pygmy	Cottus paulus (=pygmaeus)	Fish	T
Shiner, Cape Fear	Notropis mekistocholas	Fish	E
Silverside, Waccamaw	Menidia extensa	Fish	T
Darter, Bayou	Etheostoma rubrum	Fish	T
Madtom, Scioto	Noturus trautmani	Fish	E
Chub, Slender	Erimystax cahni	Fish	T
Madtom, Yellowfin	Noturus flavipinnis	Fish	T

Trout, Little Kern Golden	Oncorhynchus aguabonita whitei	Fish	T
Chub, Bonytail	Gila elegans	Fish	E
Gambusia, San Marcos	Gambusia georgei	Fish	E
Pupfish, Leon Springs	Cyprinodon bovinus	Fish	E
Sturgeon, Alabama	Scaphirhynchus suttkusi	Fish	E
Chub, Borax Lake	Gila boraxobius	Fish	E
Chub, Chihuahua	Gila nigrescens	Fish	T
Chub, Sonora	Gila ditaenia	Fish	T
Chub, Virgin River	Gila seminuda (=robusta)	Fish	E
Darter, Niangua	Etheostoma nianguae	Fish	T
Madtom, Smoky	Noturus baileyi	Fish	E
Catfish, Yaqui	Ictalurus pricei	Fish	T
Cavefish, Ozark	Amblyopsis rosae	Fish	T
Chub, Gila	Gila intermedia	Fish	E
Chub, Hutton Tui	Gila bicolor ssp.	Fish	T
Chub, Owens Tui	Gila bicolor snyderi	Fish	E
Chub, Yaqui	Gila purpurea	Fish	E
Dace, Ash Meadows Speckled	Rhinichthys osculus nevadensis	Fish	E
Dace, Clover Valley Speckled	Rhinichthys osculus oligoporus	Fish	E
Dace, Desert	Eremichthys acros	Fish	T
Dace, Foskett Speckled	Rhinichthys osculus ssp.	Fish	T
Dace, Independence Valley Speckled	Rhinichthys osculus lethoporus	Fish	E
Darter, Cherokee	Etheostoma scotti	Fish	T
Madtom, Neosho	Noturus placidus	Fish	T
Madtom, Pygmy	Noturus stanauli	Fish	E
Minnow, Devils River	Dionda diaboli	Fish	T
Minnow, Loach	Tiaroga cobitis	Fish	T
Pupfish, Ash Meadows Amargosa	Cyprinodon nevadensis mionectes	Fish	E
Pupfish, Desert	Cyprinodon macularius	Fish	E
Shiner, Beautiful	Cyprinella formosa	Fish	T
Shiner, Cahaba	Notropis cahabae	Fish	E
Shiner, Palezone	Notropis albizonatus	Fish	E
Shiner, Pecos Bluntnose	Notropis simus pecosensis	Fish	T
Spinedace, Big Spring	Lepidomeda mollispinis pratensis	Fish	T
Spinedace, Little Colorado	Lepidomeda vittata	Fish	T
Spinedace, White River	Lepidomeda albivallis	Fish	E
Springfish, Hiko White River	Crenichthys baileyi grandis	Fish	E

Springfish, Railroad Valley	Crenichthys nevadae	Fish	T
Springfish, White River	Crenichthys baileyi baileyi	Fish	E
Sturgeon, Gulf	Acipenser oxyrinchus desotoi	Fish	T
Sucker, June	Chasmistes liorus	Fish	E
Sucker, Lost River	Deltistes luxatus	Fish	E
Sucker, Modoc	Catostomus microps	Fish	E
Sucker, Razorback	Xyrauchen texanus	Fish	E
Sucker, Shortnose	Chasmistes brevirostris	Fish	E
Sucker, Warner	Catostomus warnerensis	Fish	T
Darter, Amber	Percina antesella	Fish	E
Logperch, Conasauga	Percina jenkinsi	Fish	E
Dace, Blackside	Phoxinus cumberlandensis	Fish	T
Spikedace	Meda fulgida	Fish	T
Darter, Boulder	Etheostoma wapiti	Fish	E
Darter, Goldline	Percina aurolineata	Fish	T
Shiner, Arkansas River	Notropis girardi	Fish	T
Shiner, Blue	Cyprinella caerulea	Fish	T
Trout, Bull	Salvelinus confluentus	Fish	T
Salmon, Chinook	Oncorhynchus (=Salmo) tshawytscha	Fish	E/T
Sturgeon, Pallid	Scaphirhynchus albus	Fish	E
Salmon, Sockeye	Oncorhynchus (=Salmo) nerka	Fish	E
Chub, Oregon	Oregonichthys crameri	Fish	E
Smelt, Delta	Hypomesus transpacificus	Fish	T
Goby, Tidewater	Eucyclogobius newberryi	Fish	E
Darter, Bluemask (=jewel)	Etheostoma sp.	Fish	E
Darter, Duskytail	Etheostoma percnurum	Fish	E
Minnow, Rio Grande Silvery	Hybognathus amarus	Fish	E
Salmon, Atlantic	Salmo salar	Fish	E
Shiner, Topeka	Notropis topeka (=tristis)	Fish	E
Sucker, Santa Ana	Catostomus santaanae	Fish	T
Darter, Relict	Etheostoma chienense	Fish	E
Sturgeon, White	Acipenser transmontanus	Fish	E
Darter, Etowah	Etheostoma etowahae	Fish	E
Salmon, Coho	Oncorhynchus (=Salmo) kisutch	Fish	E
Steelhead	Oncorhynchus (=Salmo) mykiss	Fish	E
Darter, Vermilion	Etheostoma chermocki	Fish	E
Sturgeon, North American green	Acipenser medirostris	Fish	T
Salmon, Chum	Oncorhynchus (=Salmo) keta	Fish	T
Sawfish, Smalltooth	Pristis pectinata	Fish	E
Pearlymussel, Cumberland Bean	Villosa trabalis	Bivalve	E

Purple Bean	Villosa perpurpurea	Bivalve	E
Pearlymussel, Green-blossom	Epioblasma torulosa gubernaculum	Bivalve	E
Pearlymussel, Tubercled-blossom	Epioblasma torulosa torulosa	Bivalve	E
Pearlymussel, Turgid-blossom	Epioblasma turgidula	Bivalve	E
Pearlymussel, Yellow-blossom	Epioblasma florentina florentina	Bivalve	E
Pearlymussel, Purple Cat's Paw	Epioblasma obliquata obliquata	Bivalve	E
Pearlymussel, White Cat's Paw	Epioblasma obliquata perobliqua	Bivalve	E
Pearlymussel, Higgins' Eye	Lampsilis higginsii	Bivalve	E
Pearlymussel, Alabama Lamp	Lampsilis virescens	Bivalve	E
Pearlymussel, Pale Lilliput	Toxolasma cylindrellus	Bivalve	E
Mussel, Winged Mapleleaf	Quadrula fragosa	Bivalve	E
Pearlymussel, Appalachian Monkeyface	Quadrula sparsa	Bivalve	E
Pearlymussel, Cumberland Monkeyface	Quadrula intermedia	Bivalve	E
Mucket, Pink (Pearlymussel)	Lampsilis abrupta	Bivalve	E
Pearlymussel, Birdwing	Conradilla caelata	Bivalve	E
Pearlymussel, Curtis'	Epioblasma florentina curtisii	Bivalve	E
Pearlymussel, Dromedary	Dromus dromas	Bivalve	E
Pearlymussel, Little-wing	Pegias fabula	Bivalve	E
Pearlymussel, White Wartyback	Plethobasus cicatricosus	Bivalve	E
Mussel, Fine-rayed Pigtoe	Fusconaia cuneolus	Bivalve	E
Mussel, Rough Pigtoe	Pleurobema plenum	Bivalve	E
Mussel, Shiny Pigtoe	Fusconaia cor	Bivalve	E
Pearlymussel, Orange-footed	Plethobasus cooperianus	Bivalve	E
Mussel, Ring Pink (=Golf Stick Pearly)	Obovaria retusa	Bivalve	E
Pearlymussel, Fat Pocketbook	Potamilus capax	Bivalve	E
Rock-pocketbook, Ouachita (=Wheeler's pm)	Arkansia wheeleri	Bivalve	E
Rabbitsfoot, Rough	Quadrula cylindrica strigillata	Bivalve	E
Mussel, Scaleshell	Leptodea leptodon	Bivalve	E
Riffleshell, Tan	Epioblasma florentina walkeri (=E. walkeri)	Bivalve	E
Mussel, Black (=Curtus' Mussel) Clubshell	Pleurobema curtum	Bivalve	E
Combshell, Southern (=Penitent mussel)	Epioblasma penita	Bivalve	E
Mussel, Flat Pigtoe (=Marshall's Mussel)	Pleurobema marshalli	Bivalve	E

Mussel, Heavy Pigtoe (=Judge Tait's Mussel)	Pleurobema taitianum	Bivalve	E
Spinymussel, Tar River	Elliptio steinstansana	Bivalve	E
Mussel, Clubshell	Pleurobema clava	Bivalve	E
Mussel, Cumberland Combshell	Epioblasma brevidens	Bivalve	E
Elktoe, Appalachian	Alasmidonta raveneliana	Bivalve	E
Mussel, Cumberland Elktoe	Alasmidonta atropurpurea	Bivalve	E
Mussel, Heelsplitter Inflated	Potamilus inflatus	Bivalve	T
Mucket, Orange-nacre	Lampsilis perovalis	Bivalve	T
Mussel, Oyster	Epioblasma capsaeformis	Bivalve	E
Pearlymussel, Cracking	Hemistena lata	Bivalve	E
Mussel, Speckled Pocketbook	Lampsilis streckeri	Bivalve	E
Spinymussel, James River	Pleurobema collina	Bivalve	E
Stirrupshell	Quadrula stapes	Bivalve	E
Mussel, Dwarf Wedge	Alasmidonta heterodon	Bivalve	E
Pearlshell, Louisiana	Margaritifera hembeli	Bivalve	T
Mussel, Acornshell Southern	Epioblasma othcaloogensis	Bivalve	E
Bankclimber, Purple	Elliptoideus sloatianus	Bivalve	T
Combshell, Upland	Epioblasma metastriata	Bivalve	E
Fanshell	Cyprogenia stegaria	Bivalve	E
Fatmucket, Arkansas	Lampsilis powelli	Bivalve	T
Mussel, Heelsplitter Carolina	Lasmigona decorata	Bivalve	E
Mussel, Oval Pigtoe	Pleurobema pyriforme	Bivalve	E
Mussel, Fine-lined Pocketbook	Lampsilis altilis	Bivalve	T
Mussel, Shiny-rayed Pocketbook	Lampsilis subangulata	Bivalve	E
Riffleshell, Northern	Epioblasma torulosa rangiana	Bivalve	E
Mussel, Fat Threeridge	Amblema neislerii	Bivalve	E
Mussel, Cumberland Pigtoe	Pleurobema gibberum	Bivalve	E
Mussel, Ovate Clubshell	Pleurobema perovatum	Bivalve	E
Mussel, Southern Clubshell	Pleurobema decisum	Bivalve	E
Kidneyshell, Triangular	Ptychobranchus greenii	Bivalve	E
Mussel, Alabama Moccasinshell	Medionidus acutissimus	Bivalve	T
Mussel, Coosa Moccasinshell	Medionidus parvulus	Bivalve	E
Mussel, Dark Pigtoe	Pleurobema furvum	Bivalve	E
Mussel, Southern Pigtoe	Pleurobema georgianum	Bivalve	E
Mussel, Gulf Moccasinshell	Medionidus penicillatus	Bivalve	E
Mussel, Ochlockonee Moccasinshell	Medionidus simpsonianus	Bivalve	E
Slabshell, Chipola	Elliptio chipolaensis	Bivalve	T
Mussel, Georgia pigtoe	Pleurobema hanleyianum	Bivalve	E
Snail, Morro Shoulderband	Helminthoglypta walkeriana	Gastropod	E
Shagreen, Magazine Mountain	Mesodon magazinensis	Gastropod	T

Snail, Chittenango Ovate Amber	Succinea chittenangoensis	Gastropod	T
Snail, Flat-spired Three-toothed	Triodopsis platysayoides	Gastropod	T
Snail, Iowa Pleistocene	Discus macclintocki	Gastropod	E
Snail, Noonday	Mesodon clarki nantahala	Gastropod	T
Snail, Painted Snake Coiled Forest	Anguispira picta	Gastropod	T
Snail, Stock Island Tree	Orthalicus reses (not incl. nesodryas)	Gastropod	T
Snail, Virginia Fringed Mountain	Polygyriscus virginianus	Gastropod	E
Riversnail, Anthony's	Athearnia anthonyi	Gastropod	E
Snail, Bliss Rapids	Taylorconcha serpenticola	Gastropod	T
Snail, Snake River Physa	Physa natricina	Gastropod	E
Ambersnail, Kanab	Oxyloma haydeni kanabensis	Gastropod	E
Marstonia, Royal (=Royal Snail)	Pyrgulopsis ogmorhaphe	Gastropod	E
Snail, Armored	Pyrgulopsis (=Marstonia) pachyta	Gastropod	E
Snail, Pecos Assiminea	Assiminea pecos	Gastropod	E
Springsnail, Alamosa	Tryonia alamosae	Gastropod	E
Springsnail, Bruneau Hot	Pyrgulopsis bruneauensis	Gastropod	E
Springsnail, Roswell	Pyrgulopsis roswellensis	Gastropod	E
Springsnail, Koster's	Juturnia kosteri	Gastropod	E
Cavesnail, Tumbling Creek	Antrobia culveri	Gastropod	E
Snail, Tulotoma	Tulotoma magnifica	Gastropod	E
Springsnail, Socorro	Pyrgulopsis neomexicana	Gastropod	E
Limpet, Banbury Springs	Lanx sp.	Gastropod	E
Elimia, Lacy	Elimia crenatella	Gastropod	T
Hornsnail, rough	Pleurocera foremani	Gastropod	E
Snail, Lioplax Cylindrical	Lioplax cyclostomaformis	Gastropod	E
Pebblesnail, Flat	Lepyrium showalteri	Gastropod	E
Rocksnail, Painted	Leptoxis taeniata	Gastropod	T
Rocksnail, Plicate	Leptoxis plicata	Gastropod	E
Rocksnail, Round	Leptoxis ampla	Gastropod	T
Campeloma, Slender	Campeloma decampi	Gastropod	E
Snail, Newcomb's	Erinna newcombi	Gastropod	T
Rocksnail, interrupted	Leptoxis foremani	Gastropod	E
Abalone, White	Haliotis sorenseni	Gastropod	E
Abalone, Black	Haliotis cracherodii	Gastropod	E
Snail, O'ahu Tree (Achatinella sowerbyana)	Achatinella sowerbyana	Gastropod	E
Snail, O'ahu Tree (Achatinella livida)	Achatinella livida	Gastropod	E
Snail, O'ahu Tree (Achatinella mustelina)	Achatinella mustelina	Gastropod	E

Snail, O'ahu Tree (Achatinella apexfulva)	Achatinella apexfulva	Gastropod	E
Snail, O'ahu Tree (Achatinella fulgens)	Achatinella fulgens	Gastropod	E
Snail, O'ahu Tree (Achatinella concavospira)	Achatinella concavospira	Gastropod	E
Snail, O'ahu Tree (Achatinella stewartii)	Achatinella stewartii	Gastropod	E
Snail, O'ahu Tree (Achatinella decipiens)	Achatinella decipiens	Gastropod	E
Snail, O'ahu Tree (Achatinella pulcherrima)	Achatinella pulcherrima	Gastropod	E
Snail, O'ahu Tree (Achatinella fuscobasis)	Achatinella fuscobasis	Gastropod	E
Snail, O'ahu Tree (Achatinella lila)	Achatinella lila	Gastropod	E
Snail, O'ahu Tree (Achatinella leucorraphe)	Achatinella leucorraphe	Gastropod	E
Snail, O'ahu Tree (Achatinella curta)	Achatinella curta	Gastropod	E
Snail, O'ahu Tree (Achatinella bulimoides)	Achatinella bulimoides	Gastropod	E
Snail, O'ahu Tree (Achatinella byronii)	Achatinella byronii	Gastropod	E
Snail, O'ahu Tree (Achatinella caesia)	Achatinella caesia	Gastropod	E
Snail, O'ahu Tree (Achatinella casta)	Achatinella casta	Gastropod	E
Snail, O'ahu Tree (Achatinella decora)	Achatinella decora	Gastropod	E
Snail, O'ahu Tree (Achatinella dimorpha)	Achatinella dimorpha	Gastropod	E
Snail, O'ahu Tree (Achatinella elegans)	Achatinella elegans	Gastropod	E
Snail, O'ahu Tree (Achatinella juncea)	Achatinella juncea	Gastropod	E
Snail, O'ahu Tree (Achatinella lehuiensis)	Achatinella lehuiensis	Gastropod	E
Snail, O'ahu Tree (Achatinella papyracea)	Achatinella papyracea	Gastropod	E
Snail, O'ahu Tree (Achatinella rosea)	Achatinella rosea	Gastropod	E
Snail, O'ahu Tree (Achatinella spaldingi)	Achatinella spaldingi	Gastropod	E
Snail, O'ahu Tree (Achatinella swiftii)	Achatinella swiftii	Gastropod	E
Snail, O'ahu Tree (Achatinella thaanumi)	Achatinella thaahumi	Gastropod	E

Snail, O'ahu Tree (Achatinella valida)	Achatinella valida	Gastropod	E
Snail, O'ahu Tree (Achatinella abbreviata)	Achatinella abbreviata	Gastropod	E
Snail, O'ahu Tree (Achatinella bellula)	Achatinella bellula	Gastropod	E
Snail, O'ahu Tree (Achatinella buddii)	Achatinella buddii	Gastropod	E
Snail, O'ahu Tree (Achatinella cestus)	Achatinella cestus	Gastropod	E
Snail, O'ahu Tree (Achatinella juddii)	Achatinella juddii	Gastropod	E
Snail, O'ahu Tree (Achatinella lorata)	Achatinella lorata	Gastropod	E
Snail, O'ahu Tree (Achatinella phaeozona)	Achatinella phaeozona	Gastropod	E
Snail, O'ahu Tree (Achatinella pupukanioe)	Achatinella pupukanioe	Gastropod	E
Snail, O'ahu Tree (Achatinella taeniolata)	Achatinella taeniolata	Gastropod	E
Snail, O'ahu Tree (Achatinella turgida)	Achatinella turgida	Gastropod	E
Snail, O'ahu Tree (Achatinella viridans)	Achatinella viridans	Gastropod	E
Snail, O'ahu Tree (Achatinella vittata)	Achatinella vittata	Gastropod	E
Snail, O'ahu Tree (Achatinella vulpina)	Achatinella vulpina	Gastropod	E
Butterfly, El Segundo Blue	Euphilotes battoides allyni	Insect	E
Butterfly, Karner Blue	Lycaeides melissa samuelis	Insect	E
Butterfly, Lange's Metalmark	Apodemia mormo langei	Insect	E
Butterfly, Lotis Blue	Lycaeides argyrognomon lotis	Insect	E
Butterfly, Mission Blue	Icaricia icarioides missionensis	Insect	E
Butterfly, Mitchell's Satyr	Neonympha mitchellii mitchellii	Insect	E
Butterfly, Myrtle's Silverspot	Speyeria zerene myrtleae	Insect	E
Butterfly, Quino Checkerspot	Euphydryas editha quino (=E. e. wrighti)	Insect	E
Butterfly, San Bruno Elfin	Callophrys mossii bayensis	Insect	E
Butterfly, Smith's Blue	Euphilotes enoptes smithi	Insect	E
Butterfly, Schaus Swallowtail	Heraclides aristodemus ponceanus	Insect	E
Butterfly, Callippe Silverspot	Speyeria callippe callippe	Insect	E
Butterfly, Oregon Silverspot	Speyeria zerene hippolyta	Insect	T
Butterfly, Palos Verdes Blue	Glaucopsyche lygdamus palosverdesensis	Insect	E

Moth, Kern Primrose Sphinx	Euproserpinus euterpe	Insect	T
Skipper, Pawnee Montane	Hesperia leonardus montana	Insect	T
Beetle, Delta Green Ground	Elaphrus viridis	Insect	T
Beetle, Valley Elderberry Longhorn	Desmocerus californicus dimorphus	Insect	T
Butterfly, Uncompahgre Fritillary	Boloria acrocnema	Insect	E
Butterfly, Bay Checkerspot (Wright's euphydryas)	Euphydryas editha bayensis	Insect	T
Naucorid, Ash Meadows	Ambrysus amargosus	Insect	T
Beetle, American Burying	Nicrophorus americanus	Insect	E
Beetle, Hungerford's Crawling Water	Brychius hungerfordi	Insect	E
Beetle, Northeastern Beach Tiger	Cicindela dorsalis dorsalis	Insect	T
Beetle, Puritan Tiger	Cicindela puritana	Insect	T
Butterfly, Behren's Silverspot	Speyeria zerene behrensii	Insect	E
Dragonfly, Hine's Emerald	Somatochlora hineana	Insect	E
Moth, Blackburn's Sphinx	Manduca blackburni	Insect	E
Beetle, Coffin Cave Mold	Batrisodes texanus	Insect	E
Beetle, Kretschmarr Cave Mold	Texamaurops reddelli	Insect	E
Beetle, Tooth Cave Ground	Rhadine persephone	Insect	E
Butterfly, Fender's Blue	Icaricia icarioides fenderi	Insect	E
Skipper, Laguna Mountain	Pyrgus ruralis lagunae	Insect	E
Fly, Delhi Sands Flower-loving	Rhaphiomidas terminatus abdominalis	Insect	E
Beetle, Comal Springs Riffle	Heterelmis comalensis	Insect	E
Beetle, Comal Springs Dryopid	Stygoparnus comalensis	Insect	E
Butterfly, Saint Francis' Satyr	Neonympha mitchellii francisci	Insect	E
Beetle, Mount Hermon June	Polyphylla barbata	Insect	E
Beetle, Ohlone Tiger	Cicindela ohlone	Insect	E
Grasshopper, Zayante Band-winged	Trimerotropis infantilis	Insect	E
Rhadine infernalis (ncn)	Rhadine infernalis	Insect	E
Beetle, Helotes Mold	Batrisodes venyivi	Insect	E
Beetle, Salt Creek Tiger	Cicindela nevadica lincolniana	Insect	E
Fly, Hawaiian picture-wing	Drosophila aglaia	Insect	E
Fly, Hawaiian picture-wing	Drosophila heteroneura	Insect	E
Fly, Hawaiian picture-wing	Drosophila montgomeryi	Insect	E
Fly, Hawaiian picture-wing	Drosophila mulli	Insect	T
Fly, Hawaiian picture-wing	Drosophila musaphilia	Insect	E
Fly, Hawaiian picture-wing	Drosophila neoclavisetae	Insect	E
Fly, Hawaiian picture-wing	Drosophila obatai	Insect	E
Fly, Hawaiian picture-wing	Drosophila substenoptera	Insect	E

Fly, Hawaiian picture-wing	Drosophila tarphytrichia	Insect	E
Fly, Hawaiian picture-wing	Drosophila hemipeza	Insect	E
Fly, Hawaiian picture-wing	Drosophila ochrobasis	Insect	E
Fly, Hawaiian picture-wing	Drosophila differens	Insect	E
Rhadine exilis (ncn)	Rhadine exilis	Insect	E
Skipper, Carson Wandering	Pseudocopaeodes eunus obscurus	Insect	E
Spider, Kauai Cave Wolf	Adelocosa anops	Arachnid	E
Harvestman, Bee Creek Cave	Texella reddelli	Arachnid	E
Harvestman, Bone Cave	Texella reyesi	Arachnid	E
Pseudoscorpion, Tooth Cave	Tartarocreagris texana	Arachnid	E
Spider, Tooth Cave	Leptoneta myopica	Arachnid	E
Spider, Spruce-fir Moss	Microhexura montivaga	Arachnid	E
Harvestman, Cokendolpher Cave	Texella cokendolpheri	Arachnid	E
Spider, Government Canyon Bat Cave	Neoleptoneta microps	Arachnid	E
Meshweaver, Madla's Cave	Cicurina madla	Arachnid	E
Meshweaver, Robber Baron Cave	Cicurina baronia	Arachnid	E
Meshweaver, Government Canyon Bat Cave	Cicurina vespera	Arachnid	E
Meshweaver, Braken Bat Cave	Cicurina venii	Arachnid	E
Amphipod, Hay's Spring	Stygobromus hayi	Crustacean	E
Isopod, Madison Cave	Antrolana lira	Crustacean	T
Amphipod, Peck's Cave	Stygobromus (=Stygonectes) pecki	Crustacean	E
Crayfish, Nashville	Orconectes shoupi	Crustacean	E
Crayfish, Shasta	Pacifastacus fortis	Crustacean	E
Shrimp, Alabama Cave	Palaemonias alabamae	Crustacean	E
Shrimp, California Freshwater	Syncaris pacifica	Crustacean	E
Shrimp, Kentucky Cave	Palaemonias ganteri	Crustacean	E
Isopod, Socorro	Thermosphaeroma thermophilus	Crustacean	E
Amphipod, Illinois Cave	Gammarus acherondytes	Crustacean	E
Amphipod, Kauai Cave	Spelaeorchestia koloana	Crustacean	E
Amphipod, Noel's	Gammarus desperatus	Crustacean	E
Isopod, Lee County Cave	Lirceus usdagalun	Crustacean	E
Shrimp, Squirrel Chimney Cave	Palaemonetes cummingi	Crustacean	T
Crayfish, Cave (Cambarus zophonastes)	Cambarus zophonastes	Crustacean	E
Crayfish, Cave (Cambarus aculabrum)	Cambarus aculabrum	Crustacean	E
Fairy Shrimp, Conservancy Fairy	Branchinecta conservatio	Crustacean	E
Fairy Shrimp, Longhorn	Branchinecta longiantenna	Crustacean	E

Fairy Shrimp, Riverside	Streptocephalus woottoni	Crustacean	E
Fairy Shrimp, Vernal Pool	Branchinecta lynchi	Crustacean	T
Tadpole Shrimp, Vernal Pool	Lepidurus packardi	Crustacean	E
Fairy Shrimp, San Diego	Branchinecta sandiegonensis	Crustacean	E
Dugong	Dugong dugon	Mammal	E
Coral, Staghorn	Acropora cervicornis	Coral	T
Coral, Elkhorn	Acropora palmata	Coral	T
Thornmint, San Diego	Acanthomintha ilicifolia	Dicot	T
Achyranthes mutica (ncn)	Achyranthes mutica	Dicot	E
Alopecurus, Sonoma	Alopecurus aequalis var. sonomensis	Monocot	E
Amaranthus brownii (ncn)	Amaranthus brownii	Dicot	E
Ambrosia, San Diego	Ambrosia pumila	Dicot	E
Rock-cress, Hoffmann's	Arabis hoffmannii	Dicot	E
Manzanita, Del Mar	Arctostaphylos glandulosa ssp. crassifolia	Dicot	E
Manzanita, Santa Rosa Island	Arctostaphylos confertiflora	Dicot	E
Manzanita, Ione	Arctostaphylos myrtifolia	Dicot	T
Manzanita, Pallid	Arctostaphylos pallida	Dicot	T
Sandwort, Bear Valley	Arenaria ursina	Dicot	T
Milk-vetch, Braunton's	Astragalus brauntonii	Dicot	E
Milk-vetch, Clara Hunt's	Astragalus clarianus	Dicot	E
Milk-vetch, Deseret	Astragalus desereticus	Dicot	T
Milk-vetch, Lane Mountain	Astragalus jaegerianus	Dicot	E
Milk-vetch, Ventura Marsh	Astragalus pycnostachyus var. lanosissimus	Dicot	E
Milk-vetch, Coastal Dunes	Astragalus tener var. titi	Dicot	E
Cactus, Star	Astrophytum asterias	Dicot	E
Barberry, Nevin's	Berberis nevinii	Dicot	E
Barberry, Island	Berberis pinnata ssp. insularis	Dicot	E
Brodiaea, Thread-leaved	Brodiaea filifolia	Monocot	T
Brodiaea, Chinese Camp	Brodiaea pallida	Monocot	T
Uhiuhi (Caesalpinia kavaiensis)	Caesalpinia kavaiense	Dicot	E
Pussypaws, Mariposa	Calyptridium pulchellum	Dicot	T
Morning-glory, Stebbins	Calystegia stebbinsii	Dicot	E
Sedge, White	Carex albida	Monocot	E
Clover, Fleshy Owl's	Castilleja campestris ssp. succulenta	Dicot	T
Paintbrush, Ash-grey Indian	Castilleja cinerea	Dicot	T
Paintbrush, Soft-leaved	Castilleja mollis	Dicot	E
Ceanothus, Pine Hill	Ceanothus roderickii	Dicot	E
Mountain-mahogany, Catalina	Cercocarpus traskiae	Dicot	E

Island			
Spurge, Hoover's	Chamaesyce hooveri	Dicot	T
Papala	Charpentiera densiflora	Dicot	E
Amole, Cammatta Canyon	Chlorogalum purpureum var. reductum	Monocot	T
Amole, Purple	Chlorogalum purpureum var. purpureum	Monocot	T
Spineflower, Orcutt's	Chorizanthe orcuttiana	Dicot	E
Thistle, Suisun	Cirsium hydrophilum var. hydrophilum	Dicot	E
Thistle, La Graciosa	Cirsium loncholepis	Dicot	E
Clarkia, Vine Hill	Clarkia imbricata	Dicot	E
'Oha Wai (Clermontia drepanomorpha)	Clermontia drepanomorpha	Dicot	E
Bird's-beak, Soft	Cordylanthus mollis ssp. mollis	Dicot	E
Haha (Cyanea humboldtiana)	Cyanea humboldtiana	Dicot	E
Ha'Iwale (Cyrtandra dentata)	Cyrtandra dentata	Dicot	E
Hiiwale	Cyrtandra oenobarba	Dicot	E
'Oha (Delissea rivularis)	Delissea rivularis	Dicot	E
'Oha (Delissea undulata)	Delissea undulata	Dicot	E
Larkspur, Baker's	Delphinium bakeri	Dicot	E
Larkspur, Yellow	Delphinium luteum	Dicot	E
Na`ena`e	Dubautia waialealae	Dicot	E
Dudleya, Conejo	Dudleya abramsii ssp. parva	Dicot	T
Dudleya, Marcescent	Dudleya cymosa ssp. marcescens	Dicot	T
Dudleya, Santa Cruz Island	Dudleya nesiotica	Dicot	T
Liveforever, Laguna Beach	Dudleya stolonifera	Dicot	T
Grass, Fosberg's Love	Eragrostis fosbergii	Monocot	E
Yerba Santa, Lompoc	Eriodictyon capitatum	Dicot	E
Buckwheat, Ione (incl. Irish Hill)	Eriogonum apricum (incl. var. prostratum)	Dicot	E
Buckwheat, Southern Mountain Wild	Eriogonum kennedyi var. austromontanum	Dicot	T
'Akoko (Euphorbia haeleeleana)	Euphorbia haeleeleana	Dicot	E
Flannelbush, Pine Hill	Fremontodendron californicum ssp. decumbens	Dicot	E
Fritillary, Gentner's	Fritillaria gentneri	Monocot	E
Bedstraw, Island	Galium buxifolium	Dicot	E
Bedstraw, El Dorado	Galium californicum ssp. sierrae	Dicot	E
Butterfly Plant, Colorado	Gaura neomexicana var. coloradensis	Dicot	T
Gilia, Hoffmann's Slender-	Gilia tenuiflora ssp. hoffmannii	Dicot	E

flowered			
Stickseed, Showy	Hackelia venusta	Dicot	E
Rush-rose, Island	Helianthemum greenei	Dicot	T
Sunflower, Pecos	Helianthus paradoxus	Dicot	T
Tarplant, Otay	Deinandra (=Hemizonia) conjugens	Dicot	T
Hau Kuahiwi (Hibiscadelphus giffardianus)	Hibiscadelphus giffardianus	Dicot	E
Hau Kuahiwi (Hibiscadelphus hualalaiensis)	Hibiscadelphus hualalaiensis	Dicot	E
Tarplant, Santa Cruz	Holocarpha macradenia	Dicot	T
Aupaka (Isodendrion laurifolium)	Isodendrion laurifolium	Dicot	E
Aupaka (Isodendrion longifolium)	Isodendrion longifolium	Dicot	T
Kamakahala (Labordia triflora)	Labordia triflora	Dicot	E
Goldfields, Contra Costa	Lasthenia conjugens	Dicot	E
'Anaunau (Lepidium arbuscula)	Lepidium arbuscula	Dicot	E
Bladderpod, Spring Creek	Lesquerella perforata	Dicot	E
Bladderpod, Zapata	Lesquerella thamnophila	Dicot	E
Lily, Pitkin Marsh	Lilium pardalinum ssp. pitkinense	Monocot	E
Woodland-star, San Clemente Island	Lithophragma maximum	Dicot	E
'Oha (Lobelia gaudichaudii koolauensis)	Lobelia gaudichaudii ssp. koolauensis	Dicot	E
Lupine, Nipomo Mesa	Lupinus nipomensis	Dicot	E
Bush-mallow, Santa Cruz Island	Malacothamnus fasciculatus var. nesioticus	Dicot	E
Alani (Melicope saint-johnii)	Melicope saint-johnii	Dicot	E
Monardella, Willowy	Monardella linoides ssp. viminea	Dicot	E
Kolea (Myrsine linearifolia)	Myrsine linearifolia	Dicot	T
Navarretia, Few-flowered	Navarretia leucocephala ssp. Pauciflora	Dicot	E
Navarretia, Many-flowered	Navarretia leucocephala ssp. plieantha	Dicot	E
Grass, Colusa	Neostapfia colusana	Monocot	T
Neraudia ovata (ncn)	Neraudia ovata	Dicot	E
Grass, Hairy Orcutt	Orcuttia pilosa	Dicot	E
Grass, Slender Orcutt	Orcuttia tenuis	Dicot	T
Lau'ehu (Panicum niihauense)	Panicum niihauense	Monocot	E
Stonecrop, Lake County	Parvisedum leiocarpum	Dicot	E
Pentachaeta, Lyon's	Pentachaeta lyonii	Dicot	E
Phacelia, Island	Phacelia insularis ssp. insularis	Dicot	E
Phlox, Yreka	Phlox hirsuta	Dicot	E

Phyllostegia hirsuta (ncn)	Phyllostegia hirsuta	Dicot	E
Phyllostegia knudsenii (ncn)	Phyllostegia knudsenii	Dicot	E
Phyllostegia parviflora (ncn)	Phyllostegia parviflora	Dicot	E
Popcornflower, Rough	Plagiobothrys hirtus	Dicot	E
Allocarya, Calistoga	Plagiobothrys strictus	Dicot	E
Bluegrass, San Bernardino	Poa atropurpurea	Monocot	E
Bluegrass, Napa	Poa napensis	Monocot	E
Potentilla, Hickman's	Potentilla hickmanii	Dicot	E
Wahane (Pritchardia aylmer-robinsonii)	Pritchardia aylmer-robinsonii	Monocot	E
Lo`ulu (Pritchardia remota)	Pritchardia remota	Monocot	E
Golden Sunburst, Hartweg's	Pseudobahia bahiifolia	Dicot	E
Adobe Sunburst, San Joaquin	Pseudobahia peirsonii	Dicot	T
kopiko	Psychotria grandiflora	Dicot	E
Sanicula purpurea (ncn)	Sanicula purpurea	Dicot	E
Schiedea hookeri (ncn)	Schiedea hookeri	Dicot	E
Ma'oli'oli (Schiedea kealiae)	Schiedea kealiae	Dicot	E
Schiedea membranacea (ncn)	Schiedea membranacea	Dicot	E
Schiedea sarmentosa (ncn)	Schiedea sarmentosa	Dicot	E
Schiedea verticillata (ncn)	Schiedea verticillata	Dicot	E
Reed-mustard, Shrubby	Schoenocrambe suffrutescens	Dicot	E
Butterweed, Layne's	Senecio layneae	Dicot	T
Rock-cress, Santa Cruz Island	Sibara filifolia	Dicot	E
Checker-mallow, Keck's	Sidalcea keckii	Dicot	E
Checker-mallow, Wenatchee Mountains	Sidalcea oregana var. calva	Dicot	E
Checker-mallow, Kenwood Marsh	Sidalcea oregana ssp. valida	Dicot	E
Catchfly, Spalding's	Silene spaldingii	Dicot	T
Taraxacum, California	Taraxacum californicum	Dicot	E
Dogweed, Ashy	Thymophylla tephroleuca	Dicot	E
Abutilon eremitopetalum (ncn)	Abutilon eremitopetalum	Dicot	E
Ko'oloa'ula (Abutilon menziesii)	Abutilon menziesii	Dicot	E
Abutilon sandwicense (ncn)	Abutilon sandwicense	Dicot	E
Liliwai (Acaena exigua)	Acaena exigua	Dicot	E
Monkshood, Northern Wild	Aconitum noveboracense	Dicot	T
Mahoe (Alectryon macrococcus)	Alectryon macrococcus	Dicot	E
Alsinidendron obovatum (ncn)	Alsinidendron obovatum	Dicot	E
Alsinidendron trinerve (ncn)	Alsinidendron trinerve	Dicot	E
Ambrosia, South Texas	Ambrosia cheiranthifolia	Dicot	E
Amphianthus, Little	Amphianthus pusillus	Dicot	T
Fiddleneck, Large-flowered	Amsinckia grandiflora	Dicot	E
Cactus, Tobusch Fishhook	Ancistrocactus tobuschii	Dicot	E

Potato-bean, Price's	Apios priceana	Dicot	T
Rock-cress, McDonald's	Arabis mcdonaldiana	Dicot	E
Rock-cress, Braun's	Arabis perstellata E. L. Braun var. ampla Rollins	Dicot	E
Rock-cress, Small	Arabis perstellata E. L. Braun var. perstellata Fernald	Dicot	E
Bearclaw poppy, Dwarf	Arctomecon humilis	Dicot	E
Manzanita, Presidio (=Raven's)	Arctostaphylos hookeri var. ravenii	Dicot	E
Poppy, Sacramento Prickly	Argemone pleiacantha ssp. pinnatisecta	Dicot	E
Silversword, Ka'u (Argyroxiphium kauense)	Argyroxiphium kauense	Dicot	E
Silversword, Haleakala ('Ahinahina)	Argyroxiphium sandwicense ssp. macrocephalum	Dicot	T
Milkweed, Mead's	Asclepias meadii	Dicot	T
Pawpaw, Four-petal	Asimina tetramera	Dicot	E
Milk-vetch, Sentry	Astragalus cremnophylax var. cremnophylax	Dicot	E
Milk-vetch, Mancos	Astragalus humillimus	Dicot	E
Milk-vetch, Osterhout	Astragalus osterhoutii	Dicot	E
Milk-vetch, Ash Meadows	Astragalus phoenix	Dicot	T
Milk-vetch, Jesup's	Astragalus robbinsii var. jesupi	Dicot	E
Rattleweed, Hairy	Baptisia arachnifera	Dicot	E
Birch, Virginia Round-leaf	Betula uber	Dicot	T
Ko'oko'olau (Bidens micrantha ssp. kalealaha)	Bidens micrantha ssp. kalealaha	Dicot	E
Ko'oko'olau (Bidens wiebkei)	Bidens wiebkei	Dicot	E
Stickyseed, Baker's	Blennosperma bakeri	Dicot	E
Bonamia menziesii (ncn)	Bonamia menziesii	Dicot	E
'Olulu (Brighamia insignis)	Brighamia insignis	Dicot	E
Pua'ala (Brighamia rockii)	Brighamia rockii	Dicot	E
Poppy-mallow, Texas	Callirhoe scabriuscula	Dicot	E
Lily, Tiburon Mariposa	Calochortus tiburonensis	Monocot	T
Bellflower, Brooksville	Campanula robinsiae	Dicot	E
'Awikiwiki (Canavalia molokaiensis)	Canavalia molokaiensis	Dicot	E
awikiwiki	Canavalia napaliensis	Dicot	E
Bittercress, Small-anthered	Cardamine micranthera	Dicot	E
Sedge, Navajo	Carex specuicola	Monocot	T
Paintbrush, San Clemente Island Indian	Castilleja grisea	Dicot	E
Ceanothus, Coyote	Ceanothus ferrisae	Dicot	E
Kamanomano (Cenchrus	Cenchrus agrimonioides	Monocot	E

agrimonioides)			
Centaury, Spring-loving	Centaurium namophilum	Dicot	T
Prickly-apple, Fragrant	Cereus eriophorus var. fragrans	Dicot	E
'Akoko (Chamaesyce celastroides var. kaenana)	Chamaesyce celastroides var. kaenana	Dicot	E
'Akoko (Chamaesyce deppeana)	Chamaesyce deppeana	Dicot	E
Spurge, Garber's	Chamaesyce garberi	Dicot	T
Chamaesyce Halemanui (ncn)	Chamaesyce halemanui	Dicot	E
Akoko	Chamaesyce remyi var. kauaiensis	Dicot	E
'Akoko (Chamaesyce skottsbergii var. skottsbe	Chamaesyce skottsbergii var. kalaeloana	Dicot	E
Spineflower, Sonoma	Chorizanthe valida	Dicot	E
Thistle, Chorro creek Bog	Cirsium fontinale var. obispoense	Dicot	E
Thistle, Fountain	Cirsium fontinale var. fontinale	Dicot	E
Clarkia, Presidio	Clarkia franciscana	Dicot	E
Clarkia, Pismo	Clarkia speciosa ssp. immaculata	Dicot	E
'Oha Wai (Clermontia lindseyana)	Clermontia lindseyana	Dicot	E
'Oha Wai (Clermontia peleana)	Clermontia peleana	Dicot	E
'Oha Wai (Clermontia pyrularia)	Clermontia pyrularia	Dicot	E
Kauila (Colubrina oppositifolia)	Colubrina oppositifolia	Dicot	E
Rosemary, Short-leaved	Conradina brevifolia	Dicot	E
Rosemary, Apalachicola	Conradina glabra	Dicot	E
Rosemary, Cumberland	Conradina verticillata	Dicot	T
Bird's-beak, salt marsh	Cordylanthus maritimus ssp. maritimus	Dicot	E
Bird's-beak, Palmate-bracted	Cordylanthus palmatus	Dicot	E
Cactus, Nellie Cory	Coryphantha minima	Dicot	E
Cactus, Bunched Cory	Coryphantha ramillosa	Dicot	T
Cactus, Lee Pincushion	Coryphantha sneedii var. leei	Dicot	T
Cactus, Sneed Pincushion	Coryphantha sneedii var. sneedii	Dicot	E
Haha (Cyanea Crispa) (=Rollandia crispa)	Cyanea (=Rollandia) crispa	Dicot	E
Haha (Cyanea grimesiana ssp. grimesiana)	Cyanea grimesiana ssp. grimesiana	Dicot	E
Haha (Cyanea mceldowneyi)	Cyanea mceldowneyi	Dicot	E
Haha (Cyanea shipmanii)	Cyanea shipmannii	Dicot	E
Haha (Cyanea St-Johnii) (=Rollandia St-Johnii)	Cyanea st-johnii	Dicot	E
Haha (Cyanea superba)	Cyanea superba	Dicot	E

Cycladenia, Jones	Cycladenia jonesii (=humilis)	Dicot	T
Ha'Iwale (Cyrtandra polyantha)	Cyrtandra polyantha	Dicot	E
Ha'Iwale (Cyrtandra subumbellata)	Cyrtandra subumbellata	Dicot	E
Delissea rhytodisperma (ncn)	Delissea rhytidosperma	Dicot	E
'Oha (Delissea subcordata)	Delissea subcordata	Dicot	E
Larkspur, San Clemente Island	Delphinium variegatum ssp. kinkiense	Dicot	E
Mint, Scrub	Dicerandra frutescens	Dicot	E
Mint, Lakela's	Dicerandra immaculata	Dicot	E
Dubautia latifolia (ncn)	Dubautia latifolia	Dicot	E
Liveforever, Santa Barbara Island	Dudleya traskiae	Dicot	E
Coneflower, Tennessee Purple	Echinacea tennesseensis	Dicot	E
Cactus, Nichol's Turk's Head	Echinocactus horizonthalonius var. nicholii	Dicot	E
Cactus, Kuenzler Hedgehog	Echinocereus fendleri var. kuenzleri	Dicot	E
Cactus, Black Lace	Echinocereus reichenbachii var. albertii	Dicot	E
Cactus, Arizona Hedgehog	Echinocereus triglochidiatus var. arizonicus	Dicot	E
Pitaya, Davis' Green	Echinocereus viridiflorus var. davisii	Dicot	E
Cactus, Lloyd's Mariposa	Echinomastus mariposensis	Dicot	T
Daisy, Maguire	Erigeron maguirei	Dicot	T
Fleabane, Zuni	Erigeron rhizomatus	Dicot	T
Mountainbalm, Indian Knob	Eriodictyon altissimum	Dicot	E
Wild-buckwheat, Gypsum	Eriogonum gypsophilum	Dicot	T
Buckwheat, Cushenbury	Eriogonum ovalifolium var. vineum	Dicot	E
Button-celery, San Diego	Eryngium aristulatum var. parishii	Dicot	E
Wallflower, Contra Costa	Erysimum capitatum var. angustatum	Dicot	E
Mustard, Penland Alpine Fen	Eutrema penlandii	Dicot	T
Frankenia, Johnston's	Frankenia johnstonii	Dicot	E
Gahnia Lanaiensis (ncn)	Gahnia lanaiensis	Monocot	E
Na'u (Gardenia brighamii)	Gardenia brighamii	Dicot	E
Fruit, Earth (=geocarpon)	Geocarpon minimum	Dicot	T
Geranium, Hawaiian Red-flowered	Geranium arboreum	Dicot	E
Avens, Spreading	Geum radiatum	Dicot	E
Gouania hillebrandii (ncn)	Gouania hillebrandii	Dicot	E
Gouania meyenii (ncn)	Gouania meyenii	Dicot	E
Gouania vitifolia (ncn)	Gouania vitifolia	Dicot	E

Haplostachys Haplostachya (ncn)	Haplostachys haplostachya	Dicot	E
Beauty, Harper's	Harperocallis flava	Monocot	E
'Awiwi (Hedyotis cookiana)	Hedyotis cookiana	Dicot	E
Kio'Ele (Hedyotis coriacea)	Hedyotis coriacea	Dicot	E
Hedyotis degeneri (ncn)	Hedyotis degeneri	Dicot	E
Pilo (Hedyotis mannii)	Hedyotis mannii	Dicot	E
Hedyotis parvula (ncn)	Hedyotis parvula	Dicot	E
Hedyotis St.-Johnii (ncn)	Hedyotis st.-johnii	Dicot	E
Dwarf-flax, Marin	Hesperolinon congestum	Dicot	T
Hesperomannia arborescens (ncn)	Hesperomannia arborescens	Dicot	E
Hesperomannia arbuscula (ncn)	Hesperomannia arbuscula	Dicot	E
Hesperomannia lydgatei (ncn)	Hesperomannia lydgatei	Dicot	E
Heartleaf, Dwarf-flowered	Hexastylis naniflora	Dicot	T
Hau Kuahiwi (Hibiscadelphus distans)	Hibiscadelphus distans	Dicot	E
Ma'o Hau Hele (Hibiscus brackenridgei)	Hibiscus brackenridgei	Dicot	E
Hibiscus, Clay's	Hibiscus clayi	Dicot	E
Koki'o Ke'oke'o (Hibiscus waimeae ssp. hannerae)	Hibiscus waimeae ssp. hannerae	Dicot	E
Rush-pea, Slender	Hoffmannseggia tenella	Dicot	E
Hypericum, Highlands Scrub	Hypericum cumulicola	Dicot	E
Wahine Noho Kula (Isodendrion pyrifolium)	Isodendrion pyrifolium	Dicot	E
Pogonia, Small Whorled	Isotria medeoloides	Monocot	T
Ivesia, Ash Meadows	Ivesia kingii var. eremica	Dicot	T
Water-willow, Cooley's	Justicia cooleyi	Dicot	E
Koki'o, Cooke's (Kokia cookei)	Kokia cookei	Dicot	E
Koki'o (Kokia drynarioides)	Kokia drynarioides	Dicot	E
Koki'o (Kokia kauaiensis)	Kokia kauaiensis	Dicot	E
Goldfields, Burke's	Lasthenia burkei	Dicot	E
Ridge-cress (=Pepper-cress), Barneby	Lepidium barnebyanum	Dicot	E
Bladderpod, Lyrate	Lesquerella lyrata	Dicot	T
Bladderpod, Kodachrome	Lesquerella tumulosa	Dicot	E
Blazing Star, Scrub	Liatris ohlingerae	Dicot	E
Lily, Western	Lilium occidentale	Monocot	E
Meadowfoam, Sebastopol	Limnanthes vinculans	Dicot	E
Nehe (Lipochaeta fauriei)	Lipochaeta fauriei	Dicot	E
Nehe (Lipochaeta lobata var. leptophylla)	Lipochaeta lobata var. leptophylla	Dicot	E
Lipochaeta venosa (ncn)	Lipochaeta venosa	Dicot	E
Lobelia niihauensis (ncn)	Lobelia niihauensis	Dicot	E

Lobelia oahuensis (ncn)	Lobelia oahuensis	Dicot	E
Lomatium, Bradshaw's	Lomatium bradshawii	Dicot	E
Broom, San Clemente Island	Lotus dendroideus ssp. traskiae	Dicot	E
Birds-in-a-nest, White	Macbridea alba	Dicot	T
Bush-mallow, San Clemente Island	Malacothamnus clementinus	Dicot	E
Manioc, Walker's	Manihot walkerae	Dicot	E
Barbara Buttons, Mohr's	Marshallia mohrii	Dicot	T
Alani (Melicope balloui)	Melicope balloui	Dicot	E
alani	Melicope degeneri	Dicot	E
Alani (Melicope haupuensis)	Melicope haupuensis	Dicot	E
Alani (Melicope knudsenii)	Melicope knudsenii	Dicot	E
Alani (Melicope lydgatei)	Melicope lydgatei	Dicot	E
Alani (Melicope mucronulata)	Melicope mucronulata	Dicot	E
Alani (Melicope munroi)	Melicope munroi	Dicot	E
Alani (Melicope ovalis)	Melicope ovalis	Dicot	E
Alani (Melicope pallida)	Melicope pallida	Dicot	E
alani	Melicope paniculata	Dicot	E
Alani (Melicope quadrangularis)	Melicope quadrangularis	Dicot	E
Alani (Melicope reflexa)	Melicope reflexa	Dicot	E
Alani (Melicope zahlbruckneri)	Melicope zahlbruckneri	Dicot	E
Blazing Star, Ash Meadows	Mentzelia leucophylla	Dicot	T
Four-o'clock, Macfarlane's	Mirabilis macfarlanei	Dicot	T
Munroidendron racemosum (ncn)	Munroidendron racemosum	Dicot	E
Neraudia angulata (ncn)	Neraudia angulata	Dicot	E
Neraudia sericea (ncn)	Neraudia sericea	Dicot	E
'Aiea (Nothocestrum breviflorum)	Nothocestrum breviflorum	Dicot	E
'Aiea (Nothocestrum peltatum)	Nothocestrum peltatum	Dicot	E
Kulu'I (Nototrichium humile)	Nototrichium humile	Dicot	E
Evening-primrose, Eureka Valley	Oenothera avita ssp. eurekensis	Dicot	E
Evening-primrose, Antioch Dunes	Oenothera deltoides ssp. howellii	Dicot	E
Grass, California Orcutt	Orcuttia californica	Monocot	E
Grass, San Joaquin Valley Orcutt	Orcuttia inaequalis	Monocot	T
Grass, Sacramento Orcutt	Orcuttia viscida	Dicot	E
Panicgrass, Carter's (Panicum fauriei var.carteri)	Panicum fauriei var. carteri	Monocot	E
Whitlow-wort, Papery	Paronychia chartacea	Dicot	T
Lousewort, Furbish	Pedicularis furbishiae	Dicot	E
Cactus, Brady Pincushion	Pediocactus bradyi	Dicot	E
Cactus, Knowlton	Pediocactus knowltonii	Dicot	E

Cactus, Peebles Navajo	Pediocactus peeblesianus peeblesianus	Dicot	E
Cactus, Siler Pincushion	Pediocactus (=Echinocactus,=Utahia) sileri	Dicot	T
Makou (Peucedanum sandwicense)	Peucedanum sandwicense	Dicot	T
Phacelia, Clay	Phacelia argillacea	Dicot	E
Phacelia, North Park	Phacelia formosula	Dicot	E
Phlox, Texas Trailing	Phlox nivalis ssp. texensis	Dicot	E
Ulihi (Phyllostegia glabra var. lanaiensis)	Phyllostegia glabra var. lanaiensis	Dicot	E
Cactus, Key Tree	Pilosocereus robinii	Dicot	E
Laukahi Kuahiwi (Plantago princeps)	Plantago princeps	Dicot	E
Bluegrass, Hawaiian	Poa sandvicensis	Monocot	E
Mint, San Diego Mesa	Pogogyne abramsii	Dicot	E
Polygala, Lewton's	Polygala lewtonii	Dicot	E
Wireweed	Polygonella basiramia	Dicot	E
Sandlace	Polygonella myriophylla	Dicot	E
Po'e (Portulaca sclerocarpa)	Portulaca sclerocarpa	Dicot	E
Pondweed, Little Aguja Creek	Potamogeton clystocarpus	Monocot	E
Lo`ulu (Pritchardia munroi)	Pritchardia munroi	Monocot	E
Plum, Scrub	Prunus geniculata	Dicot	E
Kaulu (Pteralyxia kauaiensis)	Pteralyxia kauaiensis	Dicot	E
Cliffrose, Arizona	Purshia (=cowania) subintegra	Dicot	E
Oak, Hinckley	Quercus hinckleyi	Dicot	T
Buttercup, Autumn	Ranunculus aestivalis (=acriformis)	Dicot	E
Remya kauaiensis (ncn)	Remya kauaiensis	Dicot	E
Remya, Maui	Remya mauiensis	Dicot	E
Rhododendron, Chapman	Rhododendron chapmanii	Dicot	E
Beaked-rush, Knieskern's	Rhynchospora knieskernii	Monocot	T
Gooseberry, Miccosukee	Ribes echinellum	Dicot	T
Arrowhead, Bunched	Sagittaria fasciculata	Monocot	E
Pitcher-plant, Green	Sarracenia oreophila	Dicot	E
Naupaka, Dwarf (Scaevola coriacea)	Scaevola coriacea	Dicot	E
Schiedea, Diamond Head (Schiedea adamantis)	Schiedea adamantis	Dicot	E
Schiedea kaalae (ncn)	Schiedea kaalae	Dicot	E
Bulrush, Northeastern (=Barbed Bristle)	Scirpus ancistrochaetus	Monocot	E
Cactus, Uinta Basin hookless	Sclerocactus wetlandicus	Dicot	T

Cactus, Mesa Verde	Sclerocactus mesae-verdae	Dicot	T
Cactus, Wright Fishhook	Sclerocactus wrightiae	Dicot	E
Groundsel, San Francisco Peaks	Senecio franciscanus	Dicot	T
Checker-mallow, Nelson's	Sidalcea nelsoniana	Dicot	T
Silene alexandri (ncn)	Silene alexandri	Dicot	E
Silene lanceolata (ncn)	Silene lanceolata	Dicot	E
Campion, Fringed	Silene polypetala	Dicot	E
Popolo Ku Mai (Solanum incompletum)	Solanum incompletum	Dicot	E
Popolo 'Aiakeakua (Solanum sandwicense)	Solanum sandwicense	Dicot	E
Goldenrod, White-haired	Solidago albopilosa	Dicot	T
Goldenrod, Short's	Solidago shortii	Dicot	E
Pinkroot, Gentian	Spigelia gentianoides	Dicot	E
Ladies'-tresses, Navasota	Spiranthes parksii	Monocot	E
Stenogyne angustifolia (ncn)	Stenogyne angustifolia var. angustifolia	Dicot	E
Stenogyne kanehoana (ncn)	Stenogyne kanehoana	Dicot	E
Wire-lettuce, Malheur	Stephanomeria malheurensis	Dicot	E
Jewelflower, Metcalf Canyon	Streptanthus albidus ssp. albidus	Dicot	E
Jewelflower, Tiburon	Streptanthus niger	Dicot	E
Snowbells, Texas	Styrax texanus	Dicot	E
Grass, Eureka Dune	Swallenia alexandrae	Monocot	E
Tetramolopium arenarium (ncn)	Tetramolopium arenarium	Dicot	E
Tetramolopium capillare (ncn)	Tetramolopium capillare	Dicot	E
Tetramolopium filiforme (ncn)	Tetramolopium filiforme	Dicot	E
Tetramolopium lepidotum ssp. lepidotum (ncn)	Tetramolopium lepidotum ssp. lepidotum	Dicot	E
Tetramolopium remyi (ncn)	Tetramolopium remyi	Dicot	E
Tetramolopium rockii (ncn)	Tetramolopium rockii	Dicot	T
'Ohe'ohe (Tetraplasandra gymnocarpa)	Tetraplasandra gymnocarpa	Dicot	E
(ncn)	Tetraplasandra bisattenuata	Dicot	E
Meadowrue, Cooley's	Thalictrum cooleyi	Dicot	E
Townsendia, Last Chance	Townsendia aprica	Dicot	T
Bluecurls, Hidden Lake	Trichostema austromontanum ssp. compactum	Dicot	T
Clover, Showy Indian	Trifolium amoenum	Dicot	E
Clover, Monterey	Trifolium trichocalyx	Dicot	E
Trillium, Persistent	Trillium persistens	Monocot	E
Tuctoria, Green's	Tuctoria greenei	Dicot	E
Grass, Solano	Tuctoria mucronata	Monocot	E

Opuhe (Urera kaalae)	Urera kaalae	Dicot	E
Vetch, Hawaiian (Vicia menziesii)	Vicia menziesii	Dicot	E
Vigna o-wahuensis (ncn)	Vigna o-wahuensis	Dicot	E
Pamakani (Viola chamissoniana ssp. chamissoniana)	Viola chamissoniana ssp. chamissoniana	Dicot	E
Viola helenae (ncn)	Viola helenae	Dicot	E
Nani Wai'ale'ale (Viola kauaensis var. wahiawaensis)	Viola kauaiensis var. wahiawaensis	Dicot	E
Viola lanaiensis (ncn)	Viola lanaiensis	Dicot	E
Viola oahuensis (ncn)	Viola oahuensis	Dicot	E
Iliau (Wilkesia hobdyi)	Wilkesia hobdyi	Dicot	E
A'e (Zanthoxylum hawaiiense)	Zanthoxylum hawaiiense	Dicot	E
Wild-rice, Texas	Zizania texana	Monocot	E
Pennyroyal, Todsen's	Hedeoma todsenii	Dicot	E
Sand-verbena, Large-fruited	Abronia macrocarpa	Dicot	E
Thornmint, San Mateo	Acanthomintha obovata ssp. duttonii	Dicot	E
Achyranthes splendens var. rotundata (ncn)	Achyranthes splendens var. rotundata	Dicot	E
Joint-vetch, Sensitive	Aeschynomene virginica	Dicot	T
Gerardia, Sandplain	Agalinis acuta	Dicot	E
Blue-star, Kearney's	Amsonia kearneyana	Dicot	E
Manzanita, Morro	Arctostaphylos morroensis	Dicot	T
Sandwort, Cumberland	Arenaria cumberlandensis	Dicot	E
Sandwort, Marsh	Arenaria paludicola	Dicot	E
Silversword, Mauna Kea ('Ahinahina)	Argyroxiphium sandwicense ssp. sandwicense	Dicot	E
Pelos del Diablo	Aristida portoricensis	Monocot	E
Milkweed, Welsh's	Asclepias welshii	Dicot	T
Milk-vetch, Applegate's	Astragalus applegatei	Dicot	E
Milk-vetch, Coachella Valley	Astragalus lentiginosus var. coachellae	Dicot	E
Milk-vetch, Fish Slough	Astragalus lentiginosus var. piscinensis	Dicot	T
Milk-vetch, Heliotrope	Astragalus montii	Dicot	T
Baccharis, Encinitas	Baccharis vanessae	Dicot	T
Palo de Ramon	Banara vanderbiltii	Dicot	E
Aster, Decurrent False	Boltonia decurrens	Dicot	T
Bonamia, Florida	Bonamia grandiflora	Dicot	T
Boxwood, Vahl's	Buxus vahlii	Dicot	E
Capa Rosa	Callicarpa ampla	Dicot	E
Calyptranthes Thomasiana (ncn)	Calyptranthes thomasiana	Dicot	E
Manaca, palma de	Calyptronoma rivalis	Monocot	T

Evening-primrose, San Benito	Camissonia benitensis	Dicot	T
Paintbrush, Tiburon	Castilleja affinis ssp. neglecta	Dicot	E
Paintbrush, Golden	Castilleja levisecta	Dicot	T
Chamaecrista glandulosa (ncn)	Chamaecrista glandulosa var. mirabilis	Dicot	E
Spurge, Deltoid	Chamaesyce deltoidea ssp. deltoidea	Dicot	E
Fringe Tree, Pygmy	Chionanthus pygmaeus	Dicot	E
Spineflower, Howell's	Chorizanthe howellii	Dicot	E
Spineflower, Monterey	Chorizanthe pungens var. pungens	Dicot	T
Aster, Florida Golden	Chrysopsis floridana	Dicot	E
Thistle, Pitcher's	Cirsium pitcheri	Dicot	T
Thistle, Sacramento Mountains	Cirsium vinaceum	Dicot	T
Wings, Pigeon	Clitoria fragrans	Dicot	T
Cordia bellonis (ncn)	Cordia bellonis	Dicot	E
Palo de Nigua	Cornutia obovata	Dicot	E
Cactus, Cochise Pincushion	Coryphantha robbinsorum	Dicot	T
Cactus, Pima Pineapple	Coryphantha scheeri var. robustispina	Dicot	E
Higuero De Sierra	Crescentia portoricensis	Dicot	E
Cat's-eye, Terlingua Creek	Cryptantha crassipes	Dicot	E
Gourd, Okeechobee	Cucurbita okeechobeensis ssp. okeechobeensis	Dicot	E
Haha (Cyanea pinnatifida)	Cyanea pinnatifida	Dicot	E
Haha (Cyanea platyphylla)	Cyanea platyphylla	Dicot	E
Haha (Cyanea stictophylla)	Cyanea stictophylla	Dicot	E
Ha'Iwale (Cyrtandra crenata)	Cyrtandra crenata	Dicot	E
Ha'Iwale (Cyrtandra giffardii)	Cyrtandra giffardii	Dicot	E
Ha'Iwale (Cyrtandra munroi)	Cyrtandra munroi	Dicot	E
Clover, Leafy Prairie	Dalea foliosa	Dicot	E
Daphnopsis hellerana (ncn)	Daphnopsis hellerana	Dicot	E
Pawpaw, Beautiful	Deeringothamnus pulchellus	Dicot	E
Pawpaw, Rugel's	Deeringothamnus rugelii	Dicot	E
Coneflower, Smooth	Echinacea laevigata	Dicot	E
Cactus, Chisos Mountain Hedgehog	Echinocereus chisoensis var. chisoensis	Dicot	T
Sunray, Ash Meadows	Enceliopsis nudicaulis var. corrugata	Dicot	T
Woolly-star, Santa Ana River	Eriastrum densifolium ssp. sanctorum	Dicot	E
Daisy, Parish's	Erigeron parishii	Dicot	T
Buckwheat, Scrub	Eriogonum longifolium var.	Dicot	T

	gnaphalifolium		
Wild-buckwheat, Clay-loving	Eriogonum pelinophilum	Dicot	E
Coyote-thistle, Loch Lomond	Eryngium constancei	Dicot	E
Snakeroot	Eryngium cuneifolium	Dicot	E
Wallflower, Menzie's	Erysimum menziesii	Dicot	E
Wallflower, Ben Lomond	Erysimum teretifolium	Dicot	E
Lily, Minnesota Trout	Erythronium propullans	Monocot	E
Uvillo	Eugenia haematocarpa	Dicot	E
Spurge, Telephus	Euphorbia telephioides	Dicot	T
Heau (Exocarpos luteolus)	Exocarpos luteolus	Dicot	E
Nohoanu (Geranium multiflorum)	Geranium multiflorum	Dicot	E
Gilia, Monterey	Gilia tenuiflora ssp. arenaria	Dicot	E
Goetzea, Beautiful (Matabuey)	Goetzea elegans	Dicot	E
Gumplant, Ash Meadows	Grindelia fraxino-pratensis	Dicot	T
Chumbo, Higo	Harrisia portoricensis	Dicot	T
Bluet, Roan Mountain	Hedyotis purpurea var. montana	Dicot	E
Sunflower, Schweinitz's	Helianthus schweinitzii	Dicot	E
Pink, Swamp	Helonias bullata	Monocot	T
Koki'o Ke'oke'o (Hibiscus arnottianus ssp. immaculatus)	Hibiscus arnottianus ssp. immaculatus	Dicot	E
Holly, Cook's	Ilex cookii	Dicot	E
Mallow, Peter's Mountain	Iliamna corei	Dicot	E
Iris, Dwarf Lake	Iris lacustris	Monocot	T
Hilo Ischaemum (Ischaemum byrone)	Ischaemum byrone	Monocot	E
Aupaka (Isodendrion hosakae)	Isodendrion hosakae	Dicot	E
Jacquemontia, Beach	Jacquemontia reclinata	Dicot	E
Kamakahala (Labordia cyrtandrae)	Labordia cyrtandrae	Dicot	E
Kamakahala (Labordia lydgatei)	Labordia lydgatei	Dicot	E
Kamakahala (Labordia tinifolia var. lanaiensis)	Labordia tinifolia var. lanaiensis	Dicot	E
Lepanthes eltorensis (ncn)	Lepanthes eltoroensis	Monocot	E
Clover, Prairie Bush	Lespedeza leptostachya	Dicot	T
Bladderpod, Missouri	Lesquerella filiformis	Dicot	T
Bladderpod, San Bernardino Mountains	Lesquerella kingii ssp. bernardina	Dicot	E
Blazing Star, Heller's	Liatris helleri	Dicot	T
Meadowfoam, Large-flowered Woolly	Limnanthes floccosa ssp. Grandiflora	Dicot	E
Pondberry	Lindera melissifolia	Dicot	E
Nehe (Lipochaeta kamolensis)	Lipochaeta kamolensis	Dicot	E
Nehe (Lipochaeta micrantha)	Lipochaeta micrantha	Dicot	E

Nehe (Lipochaeta tenuifolia)	Lipochaeta tenuifolia	Dicot	E
Nehe (Lipochaeta waimeaensis)	Lipochaeta waimeaensis	Dicot	E
Lobelia monostachya (ncn)	Lobelia monostachya	Dicot	E
Lupine, Clover	Lupinus tidestromii	Dicot	E
Loosestrife, Rough-leaved	Lysimachia asperulaefolia	Dicot	E
Lysimachia filifolia (ncn)	Lysimachia filifolia	Dicot	E
Monkey-flower, Michigan	Mimulus glabratus var. michiganensis	Dicot	E
Mitracarpus Maxwelliae	Mitracarpus maxwelliae	Dicot	E
Mitracarpus Polycladus	Mitracarpus polycladus	Dicot	E
kolea	Myrsine mezii	Dicot	E
Navarretia, Spreading	Navarretia fossalis	Dicot	T
Niterwort, Amargosa	Nitrophila mohavensis	Dicot	E
Beargrass, Britton's	Nolina brittoniana	Monocot	E
Palo de Rosa	Ottoschulzia rhodoxylon	Dicot	E
Dropwort, Canby's	Oxypolis canbyi	Dicot	E
Locoweed, Fassett's	Oxytropis campestris var. chartacea	Dicot	T
Penstemon, Blowout	Penstemon haydenii	Dicot	E
Pentachaeta, White-rayed	Pentachaeta bellidiflora	Dicot	E
Peperomia, Wheeler's	Peperomia wheeleri	Dicot	E
Phyllostegia mollis (ncn)	Phyllostegia mollis	Dicot	E
Butterwort, Godfrey's	Pinguicula ionantha	Dicot	T
Platanthera holochila (ncn)	Platanthera holochila	Monocot	E
Orchid, Eastern Prairie Fringed	Platanthera leucophaea	Monocot	T
Chupacallos	Pleodendron macranthum	Dicot	E
Bluegrass, Mann's (Poa mannii)	Poa mannii	Monocot	E
Poa siphonoglossa (ncn)	Poa siphonoglossa	Monocot	E
Mint, Otay Mesa	Pogogyne nudiuscula	Dicot	E
Polygala, Tiny	Polygala smallii	Dicot	E
Primrose, Maguire	Primula maguirei	Dicot	T
Harperella	Ptilimnium nodosum	Dicot	E
Sumac, Michaux's	Rhus michauxii	Dicot	E
Sandalwood, Lanai (='Iliahi)	Santalum freycinetianum var. lanaiense	Dicot	E
Pitcher-plant, Alabama Canebrake	Sarracenia rubra alabamensis	Dicot	E
Pitcher-plant, Mountain Sweet	Sarracenia rubra ssp. jonesii	Dicot	E
Chaffseed, American	Schwalbea americana	Dicot	E
Skullcap, Florida	Scutellaria floridana	Dicot	T
Skullcap, Large-flowered	Scutellaria montana	Dicot	T
'Ohai (Sesbania tomentosa)	Sesbania tomentosa	Dicot	E
Checker-mallow, Pedate	Sidalcea pedata	Dicot	E

Silene hawaiiensis (ncn)	Silene hawaiiensis	Dicot	T
Erubia	Solanum drymophilum	Dicot	E
Goldenrod, Houghton's	Solidago houghtonii	Dicot	T
Goldenrod, Blue Ridge	Solidago spithamaea	Dicot	T
Cobana Negra	Stahlia monosperma	Dicot	T
Palo Colorado (Ternstroemia luquillensis)	Ternstroemia luquillensis	Dicot	E
Ternstroemia subsessilis (ncn)	Ternstroemia subsessilis	Dicot	E
Thelypody, Howell's Spectacular	Thelypodium howellii spectabilis	Dicot	T
Mustard, Slender-petaled	Thelypodium stenopetalum	Dicot	E
Penny-cress, Kneeland Prairie	Thlaspi californicum	Dicot	E
Fringepod, Santa Cruz Island	Thysanocarpus conchuliferus	Dicot	E
Bariaco	Trichilia triacantha	Dicot	E
Vervain, California	Verbena californica	Dicot	T
Warea, Wide-leaf	Warea amplexifolia	Dicot	E
Mustard, Carter's	Warea carteri	Dicot	E
Xylosma crenatum (ncn)	Xylosma crenatum	Dicot	E
Grass, Tennessee Yellow-eyed	Xyris tennesseensis	Monocot	E
Prickly-ash, St. Thomas	Zanthoxylum thomasianum	Dicot	E
Amaranth, Seabeach	Amaranthus pumilus	Dicot	T
Milk-vetch, Holmgren	Astragalus holmgreniorum	Dicot	E
Milk-vetch, Pierson's	Astragalus magdalenae var. peirsonii	Dicot	T
Clarkia, Springville	Clarkia springvillensis	Dicot	T
Bird's-beak, Pennell's	Cordylanthus tenuis ssp. capillaris	Dicot	E
Mint, Longspurred	Dicerandra cornutissima	Dicot	E
Dudleya, Verity's	Dudleya verityi	Dicot	T
Buckwheat, Steamboat	Eriogonum ovalifolium var. williamsiae	Dicot	E
Flannelbush, Mexican	Fremontodendron mexicanum	Dicot	E
Sneezeweed, Virginia	Helenium virginicum	Dicot	T
Bladderpod, White	Lesquerella pallida	Dicot	E
Umbel, Huachuca Water	Lilaeopsis schaffneriana var. recurva	Dicot	E
Lupine, Scrub	Lupinus aridorum	Dicot	E
Mariscus pennatiformis (ncn)	Mariscus pennatiformis	Monocot	E
Myrcia Paganii	Myrcia paganii	Dicot	E
Cactus, San Rafael	Pediocactus despainii	Dicot	E
Cactus, Winkler	Pediocactus winkleri	Dicot	T
Aster, Ruth's Golden	Pityopsis ruthii	Dicot	E
Reed-mustard, Barneby	Schoenocrambe barnebyi	Dicot	E

Hayun Lagu (Tronkon Guafi)	Serianthes nelsonii	Dicot	E
Spiraea, Virginia	Spiraea virginiana	Dicot	T
Palo de Jazmin	Styrax portoricensis	Dicot	E
Clover, Running Buffalo	Trifolium stoloniferum	Dicot	E
Trillium, Relict	Trillium reliquum	Monocot	E
Lead-plant, Crenulate	Amorpha crenulata	Dicot	E
Milkpea, Small's	Galactia smallii	Dicot	E
Dawn-flower, Texas Prairie (=Texas Bitterweed)	Hymenoxys texana	Dicot	E
Mint, Garrett's	Dicerandra christmanii	Dicot	E
Howellia, Water	Howellia aquatilis	Dicot	T
Leather-flower, Alabama	Clematis socialis	Dicot	E
Haha (Cyanea grimesiana ssp. obatae)	Cyanea grimesiana ssp. obatae	Dicot	E
Haha (Cyanea hamatiflora ssp. carlsonii)	Cyanea hamatiflora ssp. Carlsonii	Dicot	E
Haha (Cyanea lobata)	Cyanea lobata	Dicot	E
Haha (Cyanea Macrostegia var. gibsonii)	Cyanea macrostegia ssp. gibsonii	Dicot	E
Spineflower, Slender-horned	Dodecahema leptoceras	Dicot	E
Na'ena'e (Dubautia herbstobatae)	Dubautia herbstobatae	Dicot	E
Mallow, Kern	Eremalche kernensis	Dicot	E
Daisy, Willamette	Erigeron decumbens var. decumbens	Dicot	E
Sunflower, San Mateo Woolly	Eriophyllum latilobum	Dicot	E
Gesneria pauciflora (ncn)	Gesneria pauciflora	Dicot	T
Heather, Mountain Golden	Hudsonia montana	Dicot	T
Daisy, Lakeside	Hymenoxys herbacea	Dicot	T
Holei (Ochrosia kilaueaensis)	Ochrosia kilaueaensis	Dicot	E
Twinpod, Dudley Bluffs	Physaria obcordata	Dicot	T
Lo`ulu (Pritchardia kaalae)	Pritchardia kaalae	Monocot	E
Lo`ulu (Pritchardia schattaueri)	Pritchardia schattaueri	Monocot	E
Water-plantain, Kral's	Sagittaria secundifolia	Monocot	T
Ma'oli'oli (Schiedea apokremnos)	Schiedea apokremnos	Dicot	E
Schiedea haleakalensis (ncn)	Schiedea haleakalensis	Dicot	E
Schiedea helleri (ncn)	Schiedea helleri	Dicot	E
Schiedea lydgatei (ncn)	Schiedea lydgatei	Dicot	E
Schiedea spergulina var. leiopoda (ncn)	Schiedea spergulina var. leiopoda	Dicot	E
Schiedea spergulina var. spergulina (ncn)	Schiedea spergulina var. spergulina	Dicot	T
Laulihilihi (Schiedea stellarioides)	Schiedea stellarioides	Dicot	E
Schoepfia arenaria (ncn)	Schoepfia arenaria	Dicot	T

Ladies'-tresses, Ute	Spiranthes diluvialis	Monocot	T
Ziziphus, Florida	Ziziphus celata	Dicot	E
Onion, Munz's	Allium munzii	Monocot	E
Alsinidendron viscosum (ncn)	Alsinidendron viscosum	Dicot	E
Rock-cress, Shale Barren	Arabis serotina	Dicot	E
Ayenia, Texas	Ayenia limitaris	Dicot	E
Jewelflower, California	Caulanthus californicus	Dicot	E
Beardtongue, Penland	Penstemon penlandii	Dicot	E
Orchid, Western Prairie Fringed	Platanthera praeclara	Monocot	T
Meadowfoam, Butte County	Limnanthes floccosa ssp. californica	Dicot	E
Cactus, Bakersfield	Opuntia treleasei	Dicot	E
Remya montgomeryi (ncn)	Remya montgomeryi	Dicot	E
Kuawawaenohu (Alsinidendron lychnoides)	Alsinidendron lychnoides	Dicot	E
Aristida chaseae (ncn)	Aristida chaseae	Monocot	E
Milk-vetch, Cushenbury	Astragalus albens	Dicot	E
Ground-plum, Guthrie's	Astragalus bibullatus	Dicot	E
Milk-vetch, Shivwits	Astragalus ampullarioides	Dicot	E
Milk-vetch, Triple-ribbed	Astragalus tricarinatus	Dicot	E
Crownscale, San Jacinto Valley	Atriplex coronata var. notatior	Dicot	E
Auerodendron pauciflorum (ncn)	Auerodendron pauciflorum	Dicot	E
Catesbaea Melanocarpa (ncn)	Catesbaea melanocarpa	Dicot	E
'Awiwi (Centaurium sebaeoides)	Centaurium sebaeoides	Dicot	E
'Akoko (Chamaesyce kuwaleana)	Chamaesyce kuwaleana	Dicot	E
Spineflower, Ben Lomond	Chorizanthe pungens var. hartwegiana	Dicot	E
Leather-flower, Morefield's	Clematis morefieldii	Dicot	E
'Oha Wai (Clermontia oblongifolia ssp. brevipes)	Clermontia oblongifolia ssp. brevipes	Dicot	E
'Oha Wai (Clermontia oblongifolia ssp. mauiensis)	Clermontia oblongifolia ssp. mauiensis	Dicot	E
Harebells, Avon Park	Crotalaria avonensis	Dicot	E
Haha (Cyanea asarifolia)	Cyanea asarifolia	Dicot	E
Haha (Cyanea copelandii ssp. copelandii)	Cyanea copelandii ssp. copelandii	Dicot	E
Haha (Cyanea dunbarii)	Cyanea dunbarii	Dicot	E
Haha (Cyanea glabra)	Cyanea glabra	Dicot	E
Haha (Cyanea mannii)	Cyanea mannii	Dicot	E
Haha (Cyanea procera)	Cyanea procera	Dicot	E
Haha (Cyanea recta)	Cyanea recta	Dicot	T
Haha (Cyanea truncata)	Cyanea truncata	Dicot	E
Cyanea undulata (ncn)	Cyanea undulata	Dicot	E

Pu'uka'a (Cyperus trachysanthos)	Cyperus trachysanthos	Monocot	E
Mapele (Cyrtandra cyaneoides)	Cyrtandra cyaneoides	Dicot	E
Ha'Iwale (Cyrtandra limahuliensis)	Cyrtandra limahuliensis	Dicot	T
Ha'Iwale (Cyrtandra tintinnabula)	Cyrtandra tintinnabula	Dicot	E
Ha'Iwale (Cyrtandra viridiflora)	Cyrtandra viridiflora	Dicot	E
na`ena`e	Dubautia imbricata imbricata	Dicot	E
Dubautia pauciflorula (ncn)	Dubautia pauciflorula	Dicot	E
Na'ena'e (Dubautia plantaginea ssp. humilis)	Dubautia plantaginea ssp. humilis	Dicot	E
Dudleya, Santa Clara Valley	Dudleya setchellii	Dicot	E
Nioi (Eugenia koolauensis)	Eugenia koolauensis	Dicot	E
Mehamehame (Flueggea neowawraea)	Flueggea neowawraea	Dicot	E
nohoanu	Geranium kauaiense	Dicot	E
Kopa (Hedyotis schlechtendahliana var. remyi)	Hedyotis schlechtendahliana var. remyi	Dicot	E
Tarplant, Gaviota	Deinandra increscens ssp. villosa	Dicot	E
Ipomopsis, Holy Ghost	Ipomopsis sancti-spiritus	Dicot	E
Walnut, Nogal	Juglans jamaicensis	Dicot	E
kamakahala	Labordia helleri	Dicot	E
kamakahala	Labordia pumila	Dicot	E
Layia, Beach	Layia carnosa	Dicot	E
Woolly-threads, San Joaquin	Monolopia (=Lembertia) congdonii	Dicot	E
Peppergrass, Slick Spot	Lepidium papilliferum	Monocot	T
Leptocereus grantianus (ncn)	Leptocereus grantianus	Dicot	E
Bladderpod, Dudley Bluffs	Lesquerella congesta	Dicot	T
Lomatium, Cook's	Lomatium cookii	Dicot	E
Lupine, Kincaid's	Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii)	Dicot	T
Lyonia truncata var. proctorii (ncn)	Lyonia truncata var. proctorii	Dicot	E
lehua makanoe	Lysimachia daphnoides	Dicot	E
Lysimachia lydgatei (ncn)	Lysimachia lydgatei	Dicot	E
Lysimachia maxima (ncn)	Lysimachia maxima	Dicot	E
Malacothrix, Santa Cruz Island	Malacothrix indecora	Dicot	E
Mariscus fauriei (ncn)	Mariscus fauriei	Monocot	E
Alani (Melicope adscendens)	Melicope adscendens	Dicot	E
alani	Melicope puberula	Dicot	E
Kolea (Myrsine juddii)	Myrsine juddii	Dicot	E
Oxytheca, Cushenbury	Oxytheca parishii var. goodmaniana	Dicot	E

Phyllostegia waimeae (ncn)	Phyllostegia waimeae	Dicot	E
Kiponapona (Phyllostegia racemosa)	Phyllostegia racemosa	Dicot	E
Phyllostegia velutina (ncn)	Phyllostegia velutina	Dicot	E
Phyllostegia warshaueri (ncn)	Phyllostegia warshaueri	Dicot	E
Phyllostegia wawrana (ncn)	Phyllostegia wawrana	Dicot	E
ho'awa	Pittosporum napaliense	Dicot	E
Laukahi Kuahiwi (Plantago hawaiensis)	Plantago hawaiensis	Dicot	E
pilo kea lau li`i	Platydesma rostrata	Dicot	E
Hala Pepe (Pleomele hawaiiensis)	Pleomele hawaiiensis	Monocot	E
Lo`ulu (Pritchardia affinis)	Pritchardia affinis	Monocot	E
lo`ulu	Pritchardia hardyi	Monocot	E
Lo`ulu (Pritchardia napaliensis)	Pritchardia napaliensis	Monocot	E
Lo`ulu (Pritchardia viscosa)	Pritchardia viscosa	Monocot	E
kopiko	Psychotria hobdyi	Dicot	E
Watercress, Gambel's	Rorippa gambellii	Dicot	E
Sanicula mariversa (ncn)	Sanicula mariversa	Dicot	E
Schiedea kauaiensis (ncn)	Schiedea kauaiensis	Dicot	E
Schiedea nuttallii (ncn)	Schiedea nuttallii	Dicot	E
Reed-mustard, Clay	Schoenocrambe argillacea	Dicot	T
Roseroot, Leedy's	Sedum integrifolium ssp. leedyi	Dicot	T
'Anunu (Sicyos alba)	Sicyos alba	Dicot	E
Silene perlmanii (ncn)	Silene perlmanii	Dicot	E
Irisette, White	Sisyrinchium dichotomum	Monocot	E
Spermolepis hawaiiensis (ncn)	Spermolepis hawaiiensis	Dicot	E
Stenogyne bifida (ncn)	Stenogyne bifida	Dicot	E
Stenogyne campanulata (ncn)	Stenogyne campanulata	Dicot	E
Trematolobelia singularis (ncn)	Trematolobelia singularis	Dicot	E
Vernonia Proctorii (ncn)	Vernonia proctorii	Dicot	E
A'e (Zanthoxylum dipetalum var. tomentosum)	Zanthoxylum dipetalum var. tomentosum	Dicot	E
Cranichis Ricartii	Cranichis ricartii	Monocot	E
Spineflower, Robust	Chorizanthe robusta va r. robusta	Dicot	E
Spineflower, Scotts Valley	Chorizanthe robusta var. hartwegii	Dicot	E
Ilex sintenisii (ncn)	Ilex sintenisii	Dicot	E
Phyllostegia mannii (ncn)	Phyllostegia mannii	Dicot	E
Sea-blite, California	Suaeda californica	Dicot	E
Rosemary, Etonia	Conradina etonia	Dicot	E
Ceanothus, Vail Lake	Ceanothus ophiochilus	Dicot	T

Lessingia, San Francisco	Lessingia germanorum (=L.g. var. germanorum)	Dicot	E
Dudleya, Santa Monica Mountains	Dudleya cymosa ssp. ovatifolia	Dicot	T
Seagrass, Johnson's	Halophila johnsonii	Monocot	T
Eugenia Woodburyana	Eugenia woodburyana	Dicot	E
Malacothrix, Island	Malacothrix squalida	Dicot	E
Piperia, Yadon's	Piperia yadonii	Monocot	E
Ladies'-tresses, Canelo Hills	Spiranthes delitescens	Monocot	E
Crownbeard, Big-leaved	Verbesina dissita	Dicot	T
Yellowhead, Desert	Yermo xanthocephalus	Dicot	T
Haha (Cyanea acuminata)	Cyanea acuminata	Dicot	E
Haha (Cyanea remyi)	Cyanea remyi	Dicot	E
Hau Kauhiwi (Hibiscadelphus woodi)	Hibiscadelphus woodii	Dicot	E
Kamakahala (Labordia tinifolia var. wahiawaen)	Labordia tinifolia var. wahiawaensis	Dicot	E
'Akoko (Chamaesyce herbstii)	Chamaesyce herbstii	Dicot	E
'Akoko (Chamaesyce rockii)	Chamaesyce rockii	Dicot	E
Haha (Cyanea koolauensis)	Cyanea koolauensis	Dicot	E
Haha (Cyanea longiflora)	Cyanea longiflora	Dicot	E
Nanu (Gardenia mannii)	Gardenia mannii	Dicot	E
Phyllostegia kaalaensis (ncn)	Phyllostegia kaalaensis	Dicot	E
Pa'iniu	Astelia waialealae	Monocot	E
Haha (Cyanea copelandii ssp. haleakalaensis)	Cyanea copelandii ssp. haleakalaensis	Dicot	E
Haha (Cyanea hamatiflora ssp. hamatiflora)	Cyanea hamatiflora ssp. hamatiflora	Dicot	E
Kanaloa kahoolawensis (ncn)	Kanaloa kahoolawensis	Dicot	E
Nesogenes rotensis (ncn)	Nesogenes rotensis	Dicot	E
Osmoxylon mariannense (ncn)	Osmoxylon mariannense	Dicot	E
'Oha Wai (Clermontia samuelii)	Clermontia samuelii	Dicot	E
Haha	Cyanea kuhihewa	Dicot	E
na`ena`e	Dubautia plantaginea magnifolia	Dicot	E
(ncn)	Lysimachia venosa	Dicot	E
(ncn)	Phyllostegia hispida	Dicot	E
(ncn)	Schiedea attenuata	Dicot	E
(ncn)	Stenogyne kealiae	Dicot	E
haha	Cyanea eleeleensis	Dicot	E
Sedge, Golden	Carex lutea	Monocot	E
'akoko	Chamaesyce eleanoriae	Dicot	E
(ncn)	Keysseria (=Lagenifera) erici	Dicot	E
(ncn)	Keysseria (=Lagenifera)	Dicot	E

	helenae		
Polygonum, Scott's Valley	Polygonum hickmanii	Dicot	E
Cactus, Pariette	Sclerocactus brevispinus	Dicot	T
Cactus, Colorado hookless	Sclerocactus glaucus	Dicot	T
Haha	Cyanea dolichopoda	Dicot	E
(ncn)	Cyanea kolekoleensis	Dicot	E
haiwale	Cyrtandra paliku	Dicot	E
Naenae	Dubautia kalalauensis	Dicot	E
Naenae	Dubautia kenwoodii	Dicot	E
(ncn)	Lysimachia iniki	Dicot	E
(ncn)	Lysimachia pendens	Dicot	E
(ncn)	Lysimachia scopulensis	Dicot	E
Kolea	Myrsine knudsenii	Dicot	E
(ncn)	Phyllostegia renovans	Dicot	E
(ncn)	Tetraplasandra flynnii	Dicot	E
Cypress, Santa Cruz	Cupressus abramsiana	Conf/cycds	E
Torreya, Florida	Torreya taxifolia	Conf/cycds	E
Cypress, Gowen	Cupressus goveniana ssp. goveniana	Conf/cycds	T
(ncn)	Diellia mannii	Ferns	E
Fern, Pendant Kihi (Adenophorus periens)	Adenophorus periens	Ferns	E
Asplenium fragile var. insulare (ncn)	Asplenium fragile var. insulare	Ferns	E
Fern, American hart's-tongue	Asplenium scolopendrium var. americanum	Ferns	T
Diellia erecta (ncn)	Diellia erecta	Ferns	E
Diellia falcata (ncn)	Diellia falcata	Ferns	E
Diplazium molokaiense (ncn)	Diplazium molokaiense	Ferns	E
Quillwort, Louisiana	Isoetes louisianensis	Ferns	E
'Ihi'Ihi (Marsilea villosa)	Marsilea villosa	Ferns	E
Fern, Aleutian Shield	Polystichum aleuticum	Ferns	E
Pteris lidgatei (ncn)	Pteris lidgatei	Ferns	E
Quillwort, Black-spored	Isoetes melanospora	Ferns	E
Quillwort, Mat-forming	Isoetes tegetiformans	Ferns	E
Pauoa (Ctenitis squamigera)	Ctenitis squamigera	Ferns	E
Tree Fern, Elfin	Cyathea dryopteroides	Ferns	E
Wawae'Iole (Phlegmariurus (=Huperzia) mannii)	Huperzia mannii	Ferns	E
Wawae'Iole (Phlegmariurus (=Lycopodium) nutans)	Lycopodium (=Phlegmariurus) nutans	Ferns	E
Fern, Alabama Streak-sorus	Thelypteris pilosa var. alabamensis	Ferns	T

Fern, Adiantum vivesii	Adiantum vivesii	Ferns	E
Diellia unisora (ncn)	Diellia unisora	Ferns	E
Fern, Elaphoglossum serpens	Elaphoglossum serpens	Ferns	E
Polystichum calderonense (ncn)	Polystichum calderonense	Ferns	E
Tectaria Estremerana	Tectaria estremerana	Ferns	E
Fern, Thelypteris inabonensis	Thelypteris inabonensis	Ferns	E
Fern, Thelypteris verecunda	Thelypteris verecunda	Ferns	E
Fern, Thelypteris yaucoensis	Thelypteris yaucoensis	Ferns	E
Diellia pallida (ncn)	Diellia pallida	Ferns	E
(ncn)	Doryopteris angelica	Ferns	E
aumakua, Palapalai	Dryopteris crinalis podosorus	Ferns	E
Cladonia, Florida Perforate	Cladonia perforata	Lichen	E
Lichen, Rock Gnome	Gymnoderma lineare	Lichen	E
Whale, North Pacific right	Eubalaena japonica	Mammal	E
Whale, beluga	Delphinapterus leucas	Mammal	E
Rockfish, Yelloweye	Sebastes ruberrimus	Fish	E
Sturgeon, Shovelnose	Scaphirhynchus platorynchus	Fish	SAT
Rockfish, Canary	Sebastes pinniger	Fish	T
Rockfish, Bocaccio	Sebastes paucispinis	Fish	E